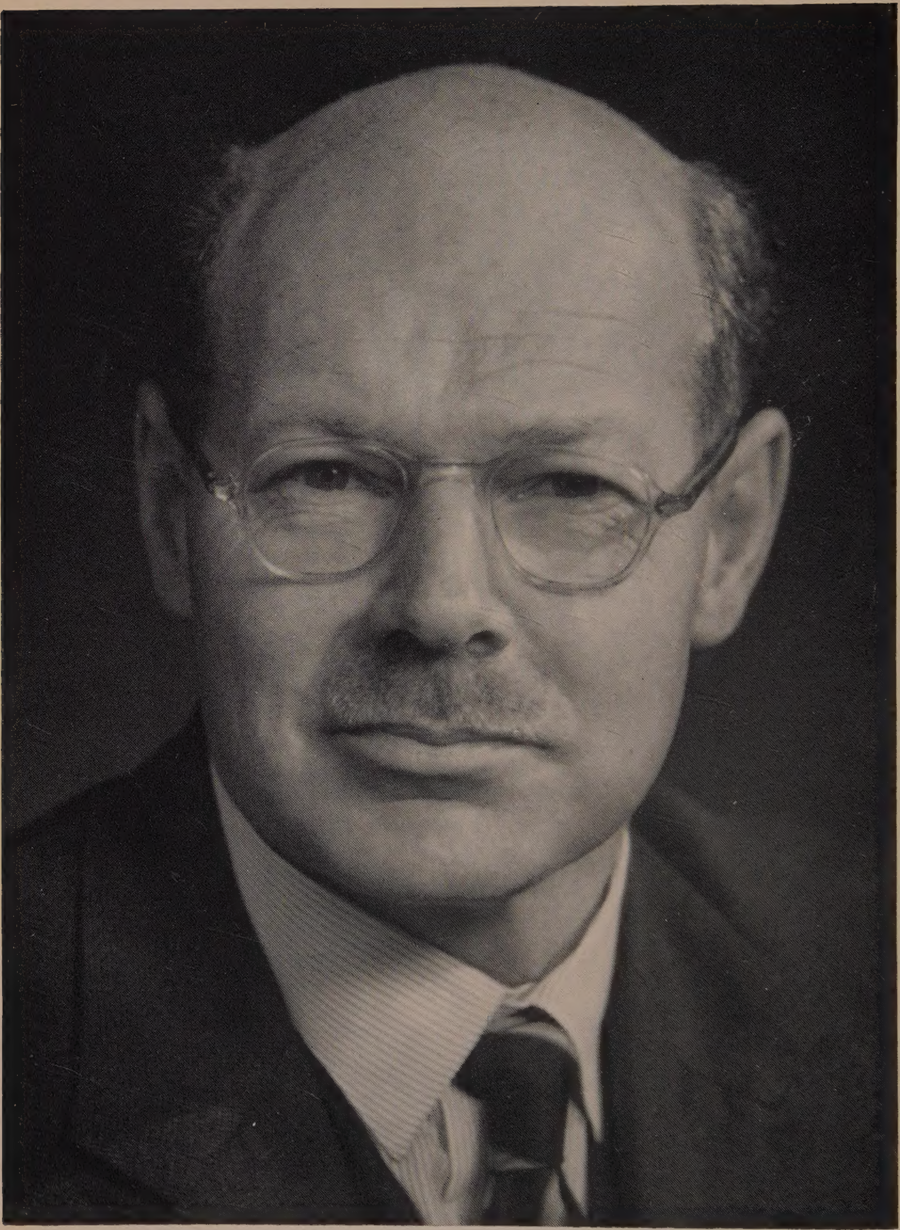
L. 8, NO. 55 JANUARY 195

THE POLAR RECORD

A Journal of Arctic and Antarctic Exploration and Research
Issued by the Scott Polar Research Institute, Cambridge



COLIN BERTRAM

THE POLAR RECORD

Editor: L. M. Forbes. Editorial Committee: G. C. L. Bertram, F. H. S. Kendon, B. B. Roberts, J. M. Wordie

Vol. 8 January, 1957 No. 55

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COLIN BERTRAM: AN APPRECIATION

A readjustment of the constitution of the Scott Polar Research Institute has been necessitated by the desire of the Treasury to re-route its grant-in-aid through the University Grants Committee. This requires a closer administrative link between the Institute and the Faculty system of the University. It has also been clear for some time that change was needed because the Institute has expanded so greatly since the original Ordinances governing it were framed thirty years ago. The Committee of Management, as advised by the Director, has reported in detail to the University, and the new constitution is likely to come into force early in 1957. One of the recommendations made to the University was that a full-time Director is now needed. Colin Bertram has advised that, in his judgement, this period of constitutional change is a suitable moment for a change in the Directorship from a part-time to a full-time appointment. Accordingly, he has resigned as from 31 December 1956. Professor J. A. Steers, Professor of Geography in the University of Cambridge, and Chairman of the Committee of Management, has consented to act as temporary Director until such time as a new Director is appointed under the new regulations.

Colin Bertram succeeded Launcelot Fleming as Director of the Institute in 1949. He now retires after seven years of valuable service. He brought to the Directorship wide polar experience in both Arctic and Antarctic: in Björnøya in 1932, east Greenland in 1933, Graham Land in 1934–37, the Pribilof Islands in 1949, a flight to the North Pole in 1952. He also had research experience in the Middle East, where he carried out biological work on coral reefs at Hurgharda in the Gulf of Suez in 1933–34, was Chief Fisheries Officer, Palestine, 1940–44, Fisheries Adviser to the Middle East Supply Centre, 1944–45, and Fisheries Adviser to the Sultan of Muscat in 1948.

The whole period of his Directorship has been one of constant change and expansion. Polar research has undergone much greater and more rapid development in this period than at any time previously, and the administrative problems of the Institute have been continuously increasing in complexity and quantity—more than can possibly be realized by those who have not been intimately concerned.

Many have not realized the rate at which changes have been taking place in the polar regions. Still less have they been prepared to face the inevitable consequences of these changes; consequences which arise from the new orientation of world power and from the willingness of governments (and inability of individuals) to expend effort and money on polar exploration. Throughout, Colin Bertram has tirelessly expounded the new approach which it is so necessary for this country to adopt; often in the face of less well-informed and less far-sighted opinion.

All will give to Colin Bertram their best wishes in his forthcoming visit to New Zealand as Williams Evans Visiting Professor to the University of Otago. He expects to return to his Tutorship at St John's College, Cambridge, in September 1957, and will then, we all hope, continue to be associated with the work of the Institute.

B.B.R.

December 1956

THE ARCTIC INSTITUTE, LENINGRAD

BY BRIAN ROBERTS AND TERENCE ARMSTRONG

[*MS. received 10 October 1956.*]

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Introduction

The writers, as representatives of the Scott Polar Research Institute, spent the period 29 May to 8 June 1956 in the U.S.S.R. as guests of the Arctic Institute [Arkticheskiy Nauchno-Issledovatel'skiy Institut]. This was part of an agreement between the two Institutes to exchange visits. Some four days were spent in the Arctic Institute, and every opportunity was afforded the writers to acquaint themselves with its work. The outline below may not always be properly balanced, for the reason that four days were not sufficient to get a complete picture of an organization of this size. It must be regarded rather as the impressions of a short but intensive visit.

Structure and personnel

This Institute belongs to Glavnoye Upravleniye Severnogo Morskogo Puti [Chief Administration of the Northern Sea Route], and its main building is at Fontanka 34, Leningrad.

This was formerly the palace of the Counts Sheremet'yev, and is a handsome late eighteenth-century building overlooking a wide canal (the Fontanka). Here are located the administrative offices, library, archives, equipment store and workshops, departments of meteorology, of oceanography and ice forecasting, of geophysics, and of geography, and laboratories of hydrochemistry, glaciology and ship design. There are in addition to this headquarters an Arctic Museum in another building in Leningrad, a department in the Northern Sea Route Administration buildings in Moscow, a laboratory in Moscow, and five arctic observatories: at Barentsburg, Bukhta Tikhaya (Zemlya Frantsa-Iosifa), Dikson, Tiksi, and Pevek.

There is a staff of about 500 in Leningrad. Most of the workers live together in blocks of flats reserved for the Institute. The leading figures are given on the facing page.

Museum of the Arctic, Leningrad

Arctic Institute, Leningrad

Photographs by T. E. Armstrong

(Facing p. 306)

V. V. Frolov, Director
A. F. Treshnikov, Deputy director
M. Ye. Ostrekin, Deputy director
V. M. Pasetskiy, Deputy director and scientific secretary of the Institute
A. P. Kibalin, Deputy director and chief administrator
M. M. Somov, Deputy director (at present in charge of the Antarctic expedition)
A. I. Mineyev, Deputy director, in charge of Moscow section of Institute
A. A. Girs, Head of Department of meteorology and weather forecasting
A. F. Laktionov, Head of Department of oceanography, ice forecasting and river mouths
A. P. Nikol'skiy, Head of Department of geophysics
Ya. Ya. Gakkel', Head of Department of geography
I. S. Peschanskiy, Head of low temperature laboratory
I. K. Yakimovich, Director of Arctic Museum

The main task of the Institute, according to the Director, is work on methods of forecasting weather and ice in the Northern Sea Route area. There is no set Five Year Plan for the Institute's work, but certain problems are allocated.

The Institute's annual budget is 30 million roubles. About two-thirds of this goes on running expeditions (of which there are perhaps five large and twenty small each year); the remaining third on running the Institute. Salaries vary from 4000 roubles a month for employees with doctorates, to 400 a month for girls doing the simplest work.

There is a research students section [*aspirantura*], numbering twenty-four. The research students work at the Institute and in the field for three years, and many get jobs in the Institute afterwards. This is one of the ways the Institute assures a supply of recruits.

Department of meteorology and weather forecasting

The head of the department is A. A. Girs. G. Ya. Vangengeym, a distinguished theorist, is a member. I. M. Dolgin is head of the climatology section. There are fifty to sixty girls in the department tabulating and working up data.

The department is the only group working on arctic weather in the U.S.S.R. (the Central Forecasting Institute at Moscow does not do any). The top priority is forecasting methods. Long-term forecasting methods are evolved from study of the general circulation of the atmosphere, and here Vangengeym is apparently the leading specialist in the country. He has made a study of typical synoptic situations over the period 1891–1956, from which he derives three main circulation patterns—easterly, westerly and meridional. Using this as a forecasting method, monthly means for temperature and pressure (including winds) are forecast up to six months in advance. The results with this method are 11 per cent better than climatological forecasts of annual means.

Bull Elephant Seal being recorded on Gough Island. The man on the left is using the Boosey and Hawkes portable recorder; on the right the moving coil microphone which is connected to the 'Vortexion' tape recorder by 200 ft. of cable (see p. 322) *Photograph by Gough Island Scientific Survey*

Short-term forecasts for one day ahead are made by the Institute's field forecasters stationed at the arctic observatories. Forecasts for three to eight days ahead are made at the Institute.

The climatological work of the Institute was summed up by Ye. A. Leont'yeva in her paper "Klimat sovetskogo sektora arktiki" [Climate of the Soviet Sector of the Arctic], published in the normal (unrestricted) series of the Institute's *Trudy* [*Transactions*], Tom 195, 1947.

Synoptic messages from the polar stations are channelled through the five arctic observatories of the Institute, whence they are sent to both the Institute and the Central Institute of Forecasting in Moscow. They come in by land line, in international code, and synoptic charts are plotted twice daily at the Institute.

A new type of portable automatic meteorological station for use on sea ice was devised in the Institute, and first used in 1956 (two are in operation). They are called "Alekseyev beacons" after their designer, Yu. K. Alekseyev. They transmit twice daily temperature, pressure, and wind speed and direction. Batteries keep them in action for a year unattended. These stations are flown out to an ice floe, where they are established and left. Their position is thereafter fixed by direction-finding from two shore stations over distances up to 2000 km. (great accuracy is neither obtained nor necessary).

The mast is made of duralumin. The clock and transmitter and the batteries are in a hermetically sealed balloon under the ice, in the water, to ensure the most constant temperature possible. The total weight of each beacon is 200 kg.

It was Vangengeym's opinion that the warming-up period in the Arctic had ended in about 1940. B. L. Dzerdyeyevskiy, another Soviet meteorologist, has reached the same conclusion. I. V. Maksimov agrees that the ice in the Northern Sea Route is getting worse; but on this point A. F. Treshnikov disagrees, as does V. F. Burkhanov, the Head of Glavsermorput'. It is probably true to say that the deterioration of ice conditions, if there is any, is more than offset by improved navigation techniques.

Department of oceanography, ice forecasting and river mouths

The head of the department is A. F. Laktionov. The head of the ice forecasting section is A. A. Kirillov, and of the river mouths section V. S. Antonov. There are 135 workers in the department; among them twenty with degrees equivalent to D.Sc. About 40 per cent of the workers in this department go on expeditions each summer. Also in the department are N. A. Volkov and P. A. Gordiyenko, both of whom were leaders of drifting stations in 1955–56, and L. L. Balakshin, who led the oceanographical expedition in the *Litke* in 1955 and that in the *Ob'* in 1956.

The Department was and is represented by two or three members at the drifting stations, where observations are made of temperature, salinity, oxygen content, bottom samples, plankton, benthos, ocean depth and currents. The leader of SP-5 in 1955–56 told us that some 300 soundings were made by echo-sounder and about the same number by line and winch during his year of drift. About half of these (300) were well fixed with sun or star sights; the remainder by dead reckoning. Timofeyev explained his work on the spreading of the layer of Atlantic water into the Central Polar Basin, based on observations by drifting stations and high latitude expeditions. He has plotted the direction of flow and changes of thickness of the layer (it averages 700 m. in thickness, with the upper limit about 300 m. below the surface). He is now computing the heat balance of the Central Polar Basin, dividing the area into seven sectors for the calculations.

The method of making long-term ice forecasts is that devised by V. Yu. Vize and printed in 1944 or 1946 by the Institute under the title of *Osnovy ledovykh prognozov* [*Principles of ice forecasting*]. Long-term forecasts are normally made in April for the first half of the shipping season and in June for the second half. Forecasts are in the form of maps showing expected ice distribution, and new editions of these maps are brought out about once a month. They are used mainly for planning ships' movements, and are transmitted by air mail to users.

Short-term forecasts, for periods of a few days ahead, are made in the field by Institute staff working at such centres as Dikson or Tiksi.

Forecasts are based on observations of weather, sea and ice. The weather information comes from the Institute's department of meteorology. The oceanographical information is collected by the Institute's staff, largely in the course of making observations at a series of standard hydrological stations, which are occupied each year as nearly as possible on the same dates. The ice information is derived chiefly from air reconnaissance. The whole Northern Sea Route area is covered about every ten days during the shipping season, and less frequently in winter. Between 12 April and 6 May 1956 for example, there were five major ice reconnaissance flights. The following table indicates the scale of these operations:

	1951	1952	1953	1954	1955
No. of aircraft	49	48	31	27	22
No. of flights	600	560	590	560	560
No. of hours	5,500	5,370	6,000	6,100	5,500
Total km.	1,650,000	1,240,000	1,340,000	1,360,000	1,250,000

It was not clear whether all these flights were exclusively for ice reconnaissance or whether ice observers had in some cases accompanied flights made for other purposes. Flights are made generally at about 2000 ft. and a map of the ice types and distribution is made during every flight on special 1:3,000,000 or 1:1,500,000 outline charts. Near land 1:500,000 has been found the most suitable scale, but in some critical areas 1:200,000 is used. The course of flight is decided by the ice observer, not the pilot. Copies of the charts showing ice conditions are often dropped at once to a ship waiting for the results of the reconnaissance. The originals are filed at the Arctic Institute, and generalized charts, showing conditions over the whole area and based on a number of flights, are also compiled for circulation to a small number of users. There is a highly developed system of recording ice types with symbols and coloured chalks. The original records show a very high standard of recording. It takes five to six months to train these observers to the necessary skill, but only after about two years are they fully trained and able to distinguish, for instance, differences in age from the air. There is normally only one ice observer for each flight, sometimes necessitating continuous observation and recording for up to fourteen hours. Two observers are only carried when new men are being trained.

There appeared to be a good and fairly frequent coverage of the whole Arctic Ocean except the Beaufort Sea, Greenland Sea and waters within about 200 miles of northern Greenland and Canada.

A radio beacon which is used to track the drift of ice floes has been in use since 1953. It is just the same as the "Alekseyev beacon" described on p. 308, but without the meteorological instruments. It weighs about 160 kg., and "several" were said to be in operation in 1956.

The river mouths section of this department is concerned with the effect of river water on the hydrology of the sea and on sea ice. On the basis of information from ships and polar stations on sea temperatures and salinities (down to 20 m. depth), charts have been compiled showing the spread of river water from the big Siberian rivers during the season. The influence of river water is much greater than was previously supposed, e.g. off the northern end of Novaya Zemlya 50 per cent of the surface water is sometimes of river origin. There is considerable annual variation. This work is not yet published, and is still at the fact-finding stage. No methods of forecasting have yet been developed.

Department of geophysics

The head of the department is A. P. Nikol'skiy, with Fedchenko as his deputy. The following work is undertaken.

(*a*) *Terrestrial magnetism.* The Institute has seven magnetic observatories (at Bukhta Tikhaya, Matochkin Shar, Dikson, Mys Chelyuskin, Tiksi, Mys Shmidta and Uelen), and magnetic work is also done at the drifting stations and during certain expeditions. There were thirteen workers in this section of the Institute reducing magnetic records, and six workers plotting charts. A portable (20 kg.) self-recording magnetometer, known as the Brunelli magnetic variation station, is made in the Institute and used at the drifting stations. It operates in light as well as darkness, records direction, horizontal and vertical force, and can be set up in two to three hours to run for twenty-four hours or six days. It will be used at the Soviet I.G.Y. stations.

Magnetic charts for air navigation, incorporating the data thus obtained, are published on a scale of 1:3,000,000, and new editions come out every five years.

(*b*) *Ionosphere.* Methods of study are apparently similar to ours. A new portable recording instrument with higher selectivity is being developed. Ionospheric observations have been made, among other places, at SP-5 and SP-3, and will be made at two drifting stations during the I.G.Y. The Institute is responsible for forecasting radio transmission conditions for polar stations.

(*c*) *Cosmic Rays.* Fedchenko is working on the meson component. The variation is observed at Bukhta Tikhaya and Mys Shmidta. Tiksi will also be used during the I.G.Y., when the neutron component will be studied.

(*d*) *Gravity.* I. V. Maksimov is associated with this department. He is working on the 14-month cycle of polar wandering.

Department of geography

The head of the department is Ya. Ya. Gakkel'.

The department has nine workers and includes a historical section under M. I. Belov (who is now working on the fourth and last volume of a history of the Northern Sea Route, shortly to start coming out).

Such biological work as the Institute does (it is very little) comes under this section. Two volumes on the birds of the Soviet Arctic by S. I. Snigirevskiy (who died early in 1956), and one on arctic vertebrates, will shortly be published by the Institute. Arctic biological work was formerly an active interest of the Institute, but responsibility for it was transferred some years ago to the Zoological Institute [Zoologicheskiy Institut] in Leningrad. All specimens and data collected by Arctic Institute expeditions are now sent to the Zoological Institute. The Arctic Institute is now only interested in animals and plants as indicators (e.g. plankton and the movement of water masses) or for their effects on sea ice.

There is a geomorphological section under G. V. Gorbatskiy.

Hydrochemical laboratory

This laboratory undertakes chemical, physical and biological analysis of seawater samples, bottom samples, and sea ice. The main object of the analysis of water samples is to determine the characteristics and hence the origin of water masses. Most of the analyses are done at the Institute's laboratory in Moscow (see p. 315–16), but urgent work is done in Leningrad. The biological work is mainly evaluation of plankton incorporated in sea ice; the prime interest being the ice, not the plankton. Analysis of bottom samples is being done by normal methods; the laboratory is at present examining 4 m. cores from north of Zemlya Frantsa-Iosifa, collected in 1956. All the workers in this laboratory have been to the Arctic.

Low temperature laboratory

I. S. Peschanskiy is in charge.

The laboratory has three cold rooms. One contains a concrete tank for testing ship models in ice. It is about 35 ft. long, 5 ft. wide and 6 ft. deep, and is filled with salt water. The thickness and mechanical properties of the ice are controlled by chemical methods. The model is pulled by a wire through the ice and water, and is filmed at the same time. A curve of resistance against ship's speed is plotted, and various other effects of ice are studied. The temperature in the room was −14° C. A model of the icebreaker *Kapitan Belousov* was being tested at the time of the visit. This is thought to be the only model-testing tank in the world where an attempt is made to simulate ice conditions at sea.

In a second small room at −40° C. experiments were being carried out on the mechanical properties of sea ice. In a third large room at −25° C. work was being done on electrical conductivity and heat conductivity of ice, measurement of thickness of floating ice by electrical methods (a very convenient portable instrument has been developed, which also gives a measure of the elasticity of the ice), determining the orientation of ice crystals by ultrasonic waves, and the testing of a seismograph to be used in the Antarctic for sounding the ice sheet.

A fourth cold room, which can be brought down to −40° C., contains a very strong concrete tank about 15 ft. long, 4 ft. wide and 8 ft. deep. This is used for testing items under pressure due to expansion of ice while freezing.

Some of the standard cold weather clothing was put on while we looked round the Arctic Institute's cold laboratories. This was warm and comfortable. It consisted of a quilted cotton anorak filled with camel hair, and knee-length footwear (the uppers a double layer of soft dogskin with hairs facing inside and outside, feet of leather lined with dogskin, and soles of felt with rubber heels). The design is suitable for sedentary work rather than travel.

Library

Bogdanov is in charge, and has a staff of five. There are about 88,000 volumes in the library, of which about 26,000 are non-Russian. The chief subjects covered are oceanography, hydro-meteorology, general and physical geography and the history of discovery, both Arctic and Antarctic, but chiefly Arctic. It was formerly more comprehensive, but had to part with a great many publications when responsibility for certain subjects was transferred to other organizations (e.g. geology to the Institute of Geology of the Arctic [Institut Geologii Arktiki], zoology to the Zoological Institute in Leningrad, and agriculture to the Research Institute of Agriculture of the Far North [Nauchno-Issledovatel'skiy Institut Zemledeliya Kraynego Severa] were specifically mentioned). These losses caused considerable disorganization.

Before 1939 about 150–170 non-Russian books were received each year; now only about 15–20 a year. One member of the library staff speaks English fluently and was particularly helpful; all seemed most anxious to co-operate on an exchange basis.

The chief responsibility of the library is to supply the needs of the staff of the Arctic Institute, but members of seventeen other organizations can also borrow books under a reciprocal exchange arrangement. It is necessary to borrow extensively from other libraries (that of the All-Union Geographical Society was said to be especially rich). Microfilms or photostats are not used, but the library holds a large collection of ordinary photographic prints of books borrowed from other libraries (enlarged from 35 mm. negatives and kept in cardboard boxes). About 3000 typed translations from publications in non-

Russian languages are held. These are prepared whenever requested by the staff of the Institute.

The library is also responsible for supplying the Institute's arctic observatories with reading matter, and therefore maintains a fiction section. There is a small photograph collection (in miscellaneous albums). Books of mounted press cuttings (in large standard loose-leaf albums) are maintained for the Arctic and Antarctic. The Institute has its own bindery, which the Library shares with the Archives department.

There are author and subject card catalogues. The entries are mostly in MS. without annotation, but printed cards received from other organizations are intercalated. The author catalogue (said to contain about 33,000 cards of which 17,000 are non-Russian) is in two separate sections: Russian and non-Russian. The subject catalogue is also in two separate sections: subjects and regions. These are both arranged by the Universal Decimal Classification, but without the use of the colon. The U.D.C. is used except for oceanography and meteorology. They have studied the new abstract of the U.D.C. for use in polar libraries which the Scott Polar Research Institute prepared and say that they like it and will translate it into Russian for their own use. They like the new internationally agreed schedules for meteorology and will adopt them, but find the present schedules for oceanographical subjects useless and are now engaged in the early stages of preparing a new draft schedule. They use the existing schedules for snow, ice and related subjects, but find them impractical and will welcome the new draft prepared by the Scott Polar Research Institute and British Glaciological Society.

Current publications of the Institute are:

(i) *Trudy*, continuing the series started in 1930, with Tom 204, 1956, as the most recent.

(ii) Another series of *Trudy* is differentiated from the main series only by numbering, which starts again at 1, and the fact that all issues are individually numbered copies and have only limited circulation.

(iii) *Informatsionnyy-bibliograficheskiy Byulleten' Novoy Inostrannoy Literatury po Arktike i Antarktike* [*Information and Bibliographical Bulletin of New Foreign Literature on Arctic and Antarctic*] comes out in cyclostyled form, with illustrations, about six times a year. It has probably been going for about six to seven years, and is to be replaced by a revived *Problemy Arktiki* [*Problems of the Arctic*], which, it was hoped, would be started by the end of 1956. Its title seems to have varied slightly from time to time.

(iv) Various special publications, including the series *Posobiya i Rukovodstva* [*Aids and Handbooks*], of which No. 31 was issued in 1953.

The Institute, it was said, has not published very much since the war. Presumably this means not much by its pre-war standards. In addition to the serials mentioned above it is preparing an annotated bibliography. The first volume, on oceanography, is to contain 35,000 titles.

It has been officially announced that all meteorological results for the U.S.S.R. will be published and made generally available by the Central Forecasting Institute at Moscow. The Director was not optimistic about the speed of publication of such a huge mass of data, but the results of the drifting stations and of the I.G.Y. have been given special priority because of the widespread interest in them. The results of SP-2 have already been published, and it is expected that the scientific results (including meteorology) of SP-3, SP-4, SP-5 and SP-6 will be published during 1957. The original meteorological records from the polar stations are kept in the Archives for reference.

Archives

The archives are in charge of four workers and consist of about 3000 bound volumes and folios. They contain all the original records of expeditions and polar stations since 1920, and as much as can be collected before that date; also material worked up in the Institute such as synoptic meteorological charts. The original maps of sea ice distribution made on ice reconnaissance flights are held here. The records are well preserved and easy to trace with the catalogue. All loose papers and charts are bound in strong plain cardboard covers, with canvas-strengthened corners and spines. This allows even large chart folios to be shelved vertically.

Equipment store and workshops

There is an instrument shop (under Ryabov) where all equipment and instruments are checked and, if necessary, repaired immediately they are returned from the field. Ryabov is also responsible for seeing that all instruments bear the necessary certificates (the calibration and certification is done by another government organization).

The equipment store is extensive, lavish and well arranged. A considerable amount of work is done on the design of equipment.

Muzey Arktiki [*Museum of the Arctic*]

The museum is part of the Arctic Institute, but is housed in a separate building (a converted church) at Ulitsa Marata, 24a, Leningrad 40. It has its own budget and its own Director, I. K. Yakimovich. It was opened in 1937, and is open to the public every day.

There are five sections:

(i) The main entrance hall is devoted to a general exposition of the nature of the Arctic. In the centre there is a large revolving arctic hemisphere in coloured relief (1:1,700,000), showing the routes of Soviet expeditions and the positions of the drifting stations, etc. Round the walls are life-size habitat groups, dioramas and models illustrating different types of country with their flora and fauna (e.g. sections of a guillemot colony in Novaya Zemlya, a Fur Seal beach in Kommandorskiye Ostrova, typical animals and birds in tundra and taiga, a relief model of Matochkin Shar). One of the aircraft used for the rescue of the *Chelyuskin* in 1934 hangs above the entrance.

(ii) Round the outside of the main hall a gallery is arranged chronologically to illustrate the history of Russian exploration, starting with seventeenth-century relics from Taymyr and concluding with the 1956 drifting stations and high latitude air expeditions. There is an interesting combination of pictures, models of ships and polar stations, etc., relics, equipment samples, coloured track charts and photographs, with sections devoted to all the chief enterprises. Papanin's original tent from SP-1, and a transportable wooden hut as used by the present drifting stations are set up fully equipped for use, together with meteorological and other scientific instruments around them. A small section covers the war in the Arctic. There is a realistic exhibit of an aurora (continuous film projected on to semi-transparent screens). The final section, a small one which they hope to expand, deals with the Antarctic: Scott, Amundsen, Bellingshausen and photographs from the current Soviet I.G.Y. expedition.

(iii) A new floor has been built half-way between the ground floor and the original domed ceiling of the church. Two stairways leading to this are lined with oil paintings of Arctic scenes.

(iv) Upstairs, a gallery running round the outside of the building contains sections of archaeology and the peoples of the north (stressing the progressive Russian influence on them, and especially contrasting the situation before and after the revolution). There are exhibits showing 'unawakened' natives; followed by exhibits of educational aspects: influence of the Decembrists and exiles, the coming of schools and alphabet books, northern newspapers and literature, native art: ivory carvings, drawings, watercolours, embroidery, decorated leatherwork.

(v) A large central hall upstairs illustrates the modern economic development of the Soviet Arctic. A series of alcoves are devoted to each industry: agriculture (specimens of crops, vegetables, etc., with maps illustrating their northward extension as a result of selective breeding), reindeer husbandry and other domestic animals, fur (types of trap, mounted fur-bearing animals, photographs of fox farms, specimens of dressed skins), fisheries (models of commercial species, fresh and canned fish, fish skin articles), minerals (specimens, models of mines, uses).

Apart from special research collections (such as the arctic archaeological specimens in Ottawa and Washington) and the specialized ethnological and archaeological exhibition of circumpolar peoples at Nationalmuseet, Copenhagen, this is surely much the best Arctic exhibition in the world.

Moscow section of Institute

The Institute has a section in Moscow under A. I. Mineyev, a Deputy director. This is apparently housed in the Glavsevmorput' building at Ulitsa Razina, 9. The work of the Moscow section, according to Mineyev, includes liaison with Glavsevmorput', economic questions, foreign literature (with G. A. Agranat as specialist on foreign arctic problems), and the working up of certain meteorological data from polar stations.

Laboratory

This is in a building not yet completed in a newly constructed suburb of Moscow, at 5-a Cheremushkinskaya Ulitsa, dom 15, korpus 4. The Director is Nesterova (who was abroad); her deputy is Maksimova and there are forty-eight staff. The laboratory is part of the Arctic Institute, and works primarily on collections made by the Institute, but at the same time it has to pay its own way by undertaking contract work for other organizations.

The chief departments deal with chemical analysis, physical analysis, mineralogy, petrology and pollen analysis. The work is entirely technological (e.g. analysis of sea-water samples from the drifting stations, making rock slices, determination of soil properties, analysis of bottom samples). No scientific evaluation is undertaken, and all the methods used are normal.

"Normal water" (on the Copenhagen and Japanese model, for determination of chlorinity) is now produced here—the only place in the Soviet Union where it is produced.

THE PHYSIOLOGY OF SLEDGE DOGS

BY R. J. F. TAYLOR

[*MS. received 7 September 1956.*]

In 1954 and 1955 the author was stationed at Hope Bay in Graham Land, as one of the twelve men at Base D of the Falkland Islands Dependencies Survey. During this time an investigation was carried out into the physiology of sledge dogs. This investigation was divided into two main parts: the first was a study of the sledging diet, and the second of the factors affecting the work output of sledge dogs.

As well as summarizing the results, this article attempts to make two particular points. The first is to demonstrate the unusual opportunity for detailed scientific work that now exists in the Falkland Islands Dependencies, and the second that such work need not be of a specialized and remote nature, but can be regarded as part of the general fabric and structure of pure science.

On average there were seventy-five dogs at Hope Bay, most of which had originally been brought from Labrador in 1944 and 1945, but are now in their third Antarctic generation.[1] Other dogs came from Canada and Greenland in 1954, and these were smaller and faster than the "native" stock.[2] Most of the investigation was carried out on a particular team of nine dogs with which the author travelled 2700 miles. The longest journey was a little under 900 miles and lasted three months.[2]

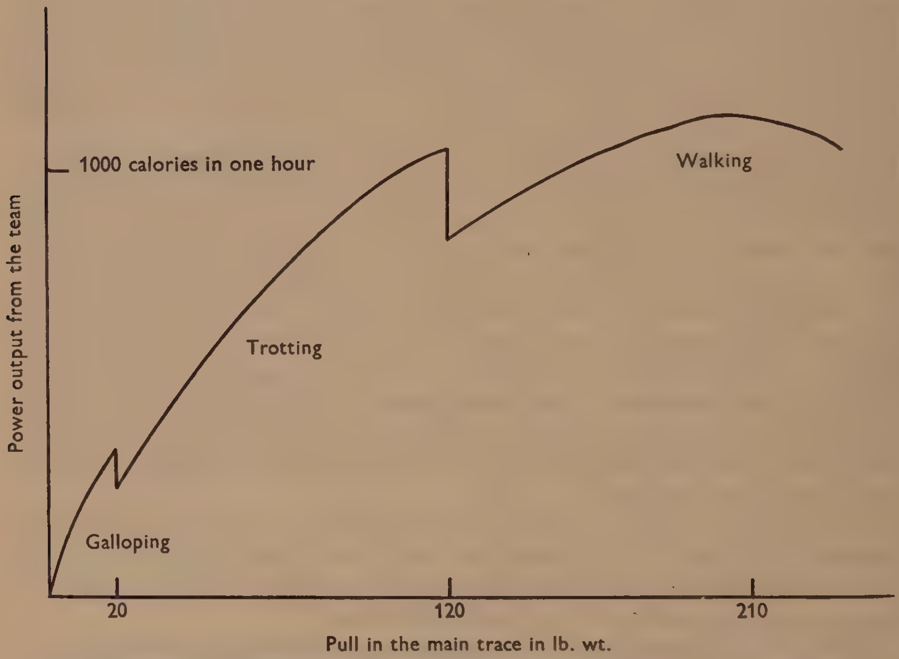
At base, dogs were fed seal meat on alternate days, but on journeys the diet consisted of "Bovril" dog pemmican, which was usually fed in 1 lb. blocks. This food has been the basis of sledging rations for dogs on British expeditions since it was first used by H. G. Watkins in 1930.

"Bovril" dog pemmican is a dry and compact food made from Argentine beef. Two-thirds of it is protein, one-third is fat and there is no carbohydrate. There is no vitamin A in pemmican, but it is not essential in a sledging ration. The reason is that the dogs receive a liberal supply of vitamin A at base, and can store sufficient in their bodies to last ten months with no further intake.

There is insufficient vitamin B_1 and an incipient deficiency was demonstrated in a dog after fifteen days on a "Bovril" dog pemmican diet.

Vitamin C is absent also from this pemmican, but dogs, like the majority of mammals, can synthesize this vitamin and so do not need a dietary supply.[3] Man, monkeys and guinea-pigs are exceptions and they develop "scurvy" with insufficient vitamin C. Recently it has been shown that rats, which normally synthesize sufficient, do not do so under extreme conditions, and it has been suggested that dogs, while sledging, might develop scurvy also. This possibility was considered, and the results were negative and conclusive. After two months on a "Bovril" dog pemmican diet with fairly rigorous conditions, dogs still synthesized more than sufficient vitamin C for their needs.

"Bovril" dog pemmican was neither absorbed nor utilized satisfactorily. The dogs passed 30 per cent of the dry matter in the diet into their faeces; the equivalent figure for man eating sledging rations is 4 per cent.[4] The bulk of the faeces from the dogs was protein, from man it is fat. The urine was saturated with urea and also contained considerable quantities of indigoid pigments. The significance of this last finding is not clear, but the evidence suggests marked disturbance in the normal processes of absorption and too much protein in the diet.[5]



Graph showing the effect of load on the power output of a team of nine dogs. The average weight of the dogs was 85 lb.

Besides this negative criticism of "Bovril" dog pemmican as a sledging ration, some positive and constructive evidence was collected. Beef, which is the basis of this food, is an expensive form of animal protein. Some pemmican was made replacing the beef by whale meat, which is cheap. This was fed to the dogs during a journey of sixteen days, and no significant difference was found in the effects of feeding the whale and beef pemmicans. The second and more important demonstration was that the dogs could absorb and utilize more fat than is in "Bovril" dog pemmican.

The ideal for any sledging ration is to have the maximum utilizable energy with a minimum of weight. This entails a low water content and a high fat diet giving little faecal residue (for fat produces twice as much energy as the same weight of carbohydrate or protein). Some of these aims are conflicting, for example a high fat diet with good utilization, and as yet there is no exact knowledge of the optimum design or even the total amount for a concentrated and complete diet for man or for any animal. A new diet has been provided by Bob Martin's Ltd., and this contains approximately 50 per cent fat, 25 per cent protein and 20 per cent carbohydrate. Thus there has been an increase in the amount of fat and carbohydrate and a reduction in protein. The theoretical calorific value is 2800 in a pound as opposed to the previous 2300, but it is hoped that in practice the difference will be more marked. The formula was decided not only from a knowledge of dogs, but more from general considerations of nutrition, in particular knowledge obtained from rats and from man. Twelve tons of the new ration went to the Falkland Islands Dependencies in the autumn of 1956.

The second line of investigation was into the work output of dogs. This depended on the measurement of the force exerted by a team of dogs pulling a sledge. The pull was measured electrically, using a new type of strain gauge developed by Saunders-Roe Ltd.[6] The pull exerted altered the electrical resistance of the gauges and this change was measured by a milliammeter mounted at the back of the sledge. Extensive records were collected with this apparatus.

Work is the product of force and distance, and so load plays a dominant part in determining work output. With no load, no "useful" work is done, however fast the team moves. With too heavy a load there is no work output as the dogs cannot move the sledge. At some intermediate load or loads the work output will be a maximum (see Fig.). The maximum speed of the particular team, unladen, was around 15 m.p.h. and the maximum pull they could exert to keep a heavy sledge moving was just over 300 lb. wt. The maximum work output occurred when trotting at 5 m.p.h. with a drag of 120 lb. wt., and when walking at 3·2 m.p.h. with a drag of 210 lb. wt. The maximum "useful" work output, from the team of nine dogs of average weight 85 lb., was 1100 Calories during one hour. For a few minutes the work output could be increased by 23 per cent. These figures for the maximum work done by the dogs are similar, weight for weight, to that produced by the "rowing eight" that won their event in the Olympic Games of 1924.[7]

It is suggested that different factors may limit the maximum work output at different loads. The suggestions are that the rate of oxygen supply to the muscles limits useful work output when trotting, and that muscle power limits useful work output when walking. These controls can be likened to fuel supply and to engine size. Dogs can only gallop with an extremely light sledge. While galloping there are instants in time when all the feet are off the ground together,[8] and so any drag will result in alternate retardations and accelerations of the body and therefore energy is wasted. It is suggested that the type of gait, the "gear box", limits maximum useful work output while galloping with a sledge, and not oxygen uptake or total muscle power.

The muscles of two sledge dogs were examined in an attempt to find the total weight of locomotory muscle. It is extremely difficult to decide from dissections exactly which muscles are employed, but a figure was obtained for the power/weight ratio of dog muscle which is slightly higher than the accepted figure for mammalian muscle of 17 watts per kilogram.[9]

During a journey, diet is rigidly controlled and the details are known as completely as "Bovril" dog pemmican can be analysed. Experiments produced a knowledge of the maintenance needs of resting dogs and the measurement of the work output enables the energy input and output to be balanced. Although this calculation does involve certain drastic assumptions, it has been carried out and three conclusions have emerged. The first is that the muscles of the dogs have an efficiency of at least 20 per cent, i.e. they convert chemical energy to mechanical energy at this figure. The second conclusion is that under "normal sledging conditions" three-quarters of the mechanical power produced in the locomotory muscles is used in moving the sledge and the other quarter is used in moving the dogs. The third conclusion is that a drop in temperature of one degree Fahrenheit demands an increase of 0·3 per cent in maintenance needs.

In the work so far described, the dogs are considered as engines. This is too simple a view and the loss of work output on journeys can be attributed both to mechanical and to psychological reasons. On a ration of 1 lb. of "Bovril" dog pemmican, the loss in work output due to mechanical and nutritional deterioration was 5 per cent a week; on 1¼ lb. and vitamin tablets, this figure was 2 per cent. However, the actual working rate during journeys varies from day to day and sometimes fell to 50 per cent of the maximum, even with good sledging surfaces. Also there were occasional marked spurts, usually with obvious mental stimuli, and it is concluded that the psychology of the dogs played a bigger part in determining the variations in their performance than their physical condition. Thus, during travel on flat and continuous sheets of ice and snow, dogs became bored, and changes in the environment, such as a visual objective, produced a marked increase in their performance. This point is well presented by Young[10] in connexion with mountaineering: "Mental distraction is as important as change of movement for the easy performance of sustained physical effort", and "Far more than any muscular strength or even physical fitness, will power is the dominant force in maintaining normal energy."

The organization of the Falkland Islands Dependencies Survey is suitable for many kinds of physiological investigation and it is hoped that another "dog physiologist" will be appointed. There is nearly complete control of feeding, breeding and exercise of the dogs, and extensive and reliable records are in existence. In fact, sledging is very similar to a laboratory experiment using a treadmill, except that the observer is taking exercise also.

Acknowledgements

Complementary to the work done in Graham Land, Professor A. N. Worden carried out some feeding tests at Huntingdon. Some of his results are included in this paper and full acknowledgement must be made to him and to Dr C. E. Waterhouse for help and advice on nutritional matters. The analysis of faeces was arranged by Dr E. M. Widdowson, who also gave much advice.

Many other people have given assistance, both in the field and at Cambridge, and the work must be considered more as a composite piece of research than an individual effort. Finally I should like to thank Dr E. Kodicek, Dr P. M. O. Massey and K. E. C. Powell, and also the Royal Society who paid for the strain gauge apparatus.

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USE OF SOUND-RECORDING EQUIPMENT BY SMALL EXPEDITIONS

BY P. J. MULLOCK

[*MS. received 5 October 1956.*]

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Introduction

This issue contains an account of the Gough Island Scientific Survey which spent the southern summer of 1955–56 exploring this previously little known island in the South Atlantic.[1] One of the tasks the expedition set itself was the making of sound recordings of the birds and seals to be found there—especially those of the rarer species. As the expedition spent, rather unexpectedly, a good deal of time on Tristan da Cunha in transit to Gough Island, it was possible to make a great many valuable recordings there also.

The recordings brought back by the expedition have proved to be so valuable that it was thought worth while to write this brief article on the subject of sound recording during expeditions. The emphasis is laid on equipment and technique suitable for small expeditions, with limited funds, and some account is given of the work in this field of the Gough Island expedition.

Equipment

There are several different media for recording sound: acetate discs, photographic film, magnetic wire and magnetic tape. Of these, the first two can be discarded immediately as unsuitable for a small expedition. Of the other two, tape has the advantage over wire for several reasons; it is capable of much better quality, it is easier to handle and easier to join and edit. Modern tapes are now adequately resistant to the elements and are much less bulky than previously; in fact magnetic tape is now universally accepted as the primary recording medium.

Tape recorders

There is now an enormous range of different types and qualities of tape recorders on the market. The problem is which type to look for.

The first thing to consider is the power supply which will be available. If "mains" power is available, then one of the standard mains recorders will be suitable. The expedition (which expression here refers to the Gough Island Scientific Survey) installed a diesel generator with a 2 kVA. output at 240 V. 50 c./s., for the communications equipment, and this was, of course, ideal. Tape recorders will not normally work off a d.c. mains supply, and even if the supply is a.c. it is important to note that many tape recorders are of the "synchronous" type in which the tape speed is proportional to the mains frequency and is locked to it, so that if the frequency of the supply is not correct, or varies, then the tape speed will do likewise. If battery power has to be used then there are still several possibilities. One can use a mains tape recorder together with some sort of power converter. The "Vortexion" vibrator supply, for example, converts battery power from a 12 V. accumulator to ordinary a.c. mains voltage and frequency and is, in fact, designed particularly for the "Vortexion" tape recorder. Unfortunately, the drain on the accumulator is somewhat heavy (about 8 to 10 amp.), so that this method is only suitable with fairly heavy duty accumulators and where charging facilities are available. Alternatively, one can use battery-operated portable tape recorders. These may be all dry-battery operated, such as the "EMI" portable tape recorder, or the mechanical part of the machine may be clockwork operated, as in the expedition's portable tape recorder. The latter type has about four times the battery life, but the speed constancy may not be so good.

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[1] P. 338.

Tape recorders may differ in many other respects and it is important to appreciate some of the technical problems in their design, and hence to be able to assess these differences.

Mechanical drive is required at three points of a tape recorder; the speed is controlled by the "capstan drive" which operates directly on to the tape, the take-up spool has to be driven (at a varying speed), and the magazine spool has to exert a small tension in the opposite direction to that in which it is actually made to rotate by the movement of the tape. The better class of machine has three separate motors to do these jobs, but it is quite common practice to have one to do the main job of driving the tape and to drive the tape reels off the same motor by a slipping clutch method.

The trueness of musical pitch on playback depends entirely on the constancy of the tape speed on record and playback. A periodic variation in tape speed of 0·5 per cent is just about detectable when music or "musical" noises are played back, though more than this may be quite unnoticeable with speech or noises such as the roar of a seal. This undesirable effect, when present, is called "wow" or "flutter". To get a good speed constancy demands good engineering in the drive mechanism and, in particular, a heavy, well-balanced capstan flywheel. With a given flywheel, the speed constancy is better the greater the angular velocity and hence tape speed. Also, for a given tape and record/playback "head" the attainable high audio frequency response is roughly proportional to tape speed. These two effects are important in considering what tape speed should be employed. Many tape recorders have a choice of two speeds. The standard tape speeds in common use are submultiples (and multiples) of 15 in./sec. Usually $3\frac{3}{4}$ in./sec. is adequate for speech, but for bird songs, music or most other noises, $7\frac{1}{2}$ in./sec. is necessary, and if really high-quality recordings are required, then 15 in./sec. should be used. With a poorer quality machine, it may be necessary to use the higher speed to get the same results anyway.

According to the erase and record/playback heads on the machine, either the whole width of the tape, or only just less than half of the width, is used at a time. The former type is a "single-track" and the latter a "twin-track" machine. The "twin-track" machine gives twice the total recording time since the reel can be turned over, when it has gone through once, and the tape run through again using the other track.

Tape recorders may be designed to be used mainly for recording purposes, with no, or limited, playback facilities, or they may have good playback facilities with a built-in loudspeaker. Mains recorders are usually of the latter type and battery portable types the former.

A tape recorder usually has facilities for erasing tapes so that, when recording, any previous recording is automatically erased first. The crude method of erasing by means of a permanent magnet is now rarely used as this leaves the tape in a noisy state. "Supersonic" erase is therefore almost always employed. Some tape recorders, however, and in particular many of the battery portables, have no built-in erase facilities and tapes have to be erased on a special "bulk-eraser" which works off a.c. mains. These are not expensive and often get the tape "cleaner" than a supersonic eraser. It takes only a few seconds to erase a whole reel by this means.

A tape recorder may have, in addition to an erase head, either a combined record/playback head, or separate record and playback heads. The latter type has the advantage that one can monitor what has actually been recorded a fraction of a second after recording. In practice, however, this requires an additional amplifier, which almost doubles the amount of electronic equipment in the machine. The two-head type is usually adequate, if one can run the risk of having to do the recording again.

An important part of the tape recorder is some form of "modulation" indicator. Magnetic tape can only be magnetized up to a certain degree in a linear manner. It is therefore important to be able to adjust the "gain", or "volume", control so that the loudest noise being recorded will just not cause distortion. The degree of magnetization, called the "modulation depth", should be as high as is consistent with low distortion, in order that the small amount of inherent noise in the amplifier and on the tape will be unnoticeable. The modulation indicator may be a meter, a "magic eye" valve, a neon tube or some other special type.

There are a few other points to be watched in choosing a tape recorder, such as portability, low noise level ("hum" is a particular bugbear) and simplicity of operation. The latter is an important point if the machine is to be operated by people who do not really understand exactly what each control does. Even then it is amazing how easy it is to overlook the setting of one control and so spoil a recording.

Tape

Plastic ¼ in. wide tape with a magnetic oxide coating on one side is almost always used. Paper tape is rarely used, though it is possible that it may have an application in some severe climates. The appropriate standard sizes of reel on which tape is supplied are 5, 7 or 8¼ in. diameter holding 600, 1200 or 1750 ft. of the normal thickness tape. At the standard tape speed of 7½ in./sec. these give 16, 32 or 45 min. respectively, for continuous running. However, several companies have now produced a much thinner tape on a new plastic base, so that half the length of tape again can be got on a reel, giving greatly extended playing time. This tape, which is stronger if anything, is also much to be preferred on account of its greater resistance to humidity. The reels themselves are made of a number of different plastics, paxolin or a light aluminium alloy. Of the latter type, "Ferrograph" produce a type which locks on to the motor hub and also has a clip which grips the tape, facilitating loading.

Instead of the conventional reels, one may use an "endless loop cassette". Such an article is produced by Wright and Weaire (to fit on to their own tapedecks) holding sufficient tape for about 4 min. recording time at 7½ in./sec. The machine can then be left recording for many hours if necessary, until a particular bird call, say, is heard, and then that bit of tape is taken off.

Microphones

The types of microphone to be used should be given serious consideration; in any case it is desirable to have several available.

A good ribbon microphone has an excellent frequency response of high quality, but it is necessary for the microphone to face the source of sound for proper balance. This microphone is really only suitable for indoor work as it is very sensitive to winds.

A good moving coil microphone is much more robust, but will usually have a somewhat reduced high-frequency response. However, it is more or less uniformly sensitive in all forward directions, is somewhat more sensitive than a ribbon and less sensitive to wind noise. It is most useful in the open or where the sounds are coming from a number or different directions.

Both these microphones are low impedance and can usually be freely interchanged. Either may be used with long microphone cables, which is a considerable advantage.

Crystal microphones are either of the "sound-cell" or the "diaphragm" type. The former is omnidirectional and of excellent quality, but rather insensitive requiring a high-gain recording amplifier. The diaphragm type is very much more sensitive than any of the other microphones, but is not of such good quality. These are both high impedance microphones and, particularly the sound-cell type, cannot be used with long leads without a danger of hum or reduced output.

Tape recorders are usually designed for either low impedance or high impedance input, but not both. The former is to be preferred if a choice must be made.

When recording indoors, it is important to watch acoustical resonances. It was found that when recording examples of Tristan speech, the simple expedient of hanging blankets round the walls obviated this difficulty adequately. The main problem outside is wind-noise; it is essential that the microphone be screened from the wind or the most undesirable noises will be recorded. A very useful accessory for recording in the open is a paraboloid reflector. "Vortexion" manufacture two types; the smaller one is adequate, having a diameter of 18 in., and is used with a moving coil microphone. Although not as directional as the larger (3 ft.) type, it is adequate for most purposes. It does give a much greater effective range to the microphone and is also invaluable for cutting out ambient noise.

Editing

When making numerous recordings in the field it is all too easy to get behind with editing. Brief announcements in each section of recording should be made by the operator to avoid possible confusion later. It is advisable to edit tapes and collect recordings together, on separate reels, under the different subject headings. This will save much time later. Editing is done by the usual procedure of cutting the tape and making a diagonal splice held together with a piece of splicing tape. A splicing jig, such as that made by "Multicore Solders Ltd.", is very useful and saves time. A good splice should not produce any click on playback.

It is perhaps an obvious point, but one which cannot be mentioned too often, that great care be taken not to erase recordings accidentally—it is done much too easily. It is particularly important to number all tapes, and see that they are always rewound on to the same reels. A full catalogue of all recordings is essential. If a "twin-track" machine is used, it is necessary to use only one of the two tracks to allow editing of the tape by cutting and splicing. If tape runs short, recordings can be made on the second track which will remain unedited until the material can be copied at a later date.

Equipment of Gough Island Scientific Survey

In order to illustrate the foregoing points, the equipment taken by the expedition is described.

Two tape recorders were used:

(1) A "Vortexion" mains tape recorder using a Wright and Weaire 2A deck. This is semi-portable with a weight of about 50 lb. It is a "twin-track" machine with two speeds ($3\frac{3}{4}$ in./sec. and $7\frac{1}{2}$ in./sec.), two heads, provision for up to $8\frac{1}{4}$ in. reels, low impedance input and a monitoring speaker. The frequency response at $7\frac{1}{2}$ in./sec. is substantially constant from 30 to 14,000 c./s.; the "wow" is negligible.

(2) A Boosey and Hawkes clockwork/battery portable "Reporter" tape recorder, weighing 12 lb. This is a single-track, single-head (no erase facilities), high impedance input machine. The speed is variable from $7\frac{1}{2}$ in./sec. to 15 in./

sec. and it was always used at the latter, when the "wow" was tolerable for most purposes. Reels of up to five inches only could be used. There are no proper replay facilities and only a jack socket for monitoring with headphones. The amplifier gain is sufficient only for a diaphragm type crystal microphone and there is no modulation indicator.

A "Vortexion" vibrator pack was used extensively on Tristan da Cunha with the "Vortexion" tape recorder, where no other power supply was available.

"Scotchboy" tape (and splicing tape) was used in the following quantities: twelve 1200 ft. reels, twelve 600 ft. reels and twelve 900 ft. reels (the latter being the new thin type). This quantity proved to be just enough. Much of the tape was taken out with music recorded on it, and used for entertainment until the tape was actually required.

A Leevers-Rich "LeeRaser" bulk tape eraser was used in conjunction with the portable recorder.

The ribbon microphone (M8) and moving coil microphone (M7) were manufactured by Film Industries. An "Acos" MIC-16 was also available.

Up to 200 yd. of Belling-Lee microphone cable was used; it was kept ready in lengths with plugs and sockets already fitted for convenience.

The paraboloid and endless loop cassette, as previously mentioned, completed the equipment apart from the numerous spare valves, components and batteries.

Results

Both recorders were used in conjunction with the filming for recording commentaries on landing operations and interviews with Tristan islanders, etc.

Quite a good set of recordings was made of Tristan Islanders' speech, folk-songs and native dance music. These were all done using the "Vortexion" and vibrator pack. With the limited facilities available it was found rather difficult to keep the accumulators charged.

On Gough Island the birds and seals were extensively recorded. The petrels and other "night-birds" were mostly recorded in "studio" conditions. They were caught at night by floodlight and recorded with the ribbon microphone in the hut, using the "Vortexion".

Some recordings of the Wandering Albatross and the Yellow-nosed Albatross were made away from base, using the portable recorder. It is appropriate here to repeat the warning about over-modulating tape. Several of the expedition's recordings made with the portable recorder were marred by the deceptive loudness of these birds and the seals.

The indigenous Bunting was also mainly recorded with the portable machine. The results seem satisfactory, but the high frequency part of the Bunting's song could not be recorded satisfactorily.

The "Vortexion" recorder was always kept in the same position in the wireless room and recordings made inside, or by the use of long lengths of microphone cable. Skuas were recorded in the hut but it was difficult to obtain much more than the warning calls of these and other birds by this method.

The Flightless Rail was recorded outside with the "Vortexion", using the moving coil microphone and, usually, the paraboloid reflector as well. This bird has a wide variety of calls and a comprehensive collection was obtained. For some of the Rail's rarer calls the endless loop cassette proved invaluable and the tape recorder was sometimes kept running all day. Here the paraboloid mainly served to cut out the noise from the generator.

The massed voices of the "night-birds" made quite an impressive recording. The paraboloid, pointing upwards, was again used to cut out wind, surf, stream and engine noise.

Fur Seals were recorded away from base, using the portable recorder. Both machines were used for the Elephant Seal; better results were obtained with the "Vortexion".

AUSTRALIAN NATIONAL ANTARCTIC RESEARCH EXPEDITION BUILDINGS IN ANTARCTICA

BY PHILLIP LAW[1]

[*MS. received 7 August 1956.*]

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"*Mark I*" *type*

In 1949 the Antarctic Division of the Department of External Affairs was faced with a large building programme, due to the expanding scientific programme at the Heard Island and Macquarie Island stations, and the fact that a number of the huts already in use, chosen hurriedly in 1947 from surplus war stocks, had proved unsuitable. From then onwards I spent a great amount of time, in collaboration with architects of the Commonwealth Department of Works and private contractors, investigating various building materials and methods of construction. In 1949 we decided in favour of a hut in which wall, floor and roof panels were all of similar construction, and could be repeated in the longitudinal direction of the hut to provide a building of any desired length. In the "Mark I" design of this hut a timber frame was erected and the panels were then affixed.

Huts of this type, which were erected in 1950, included a meteorological hut and magnetic huts for Macquarie Island (the latter demanded a use of magnetically-tested brass in place of all ferrous metals). The novel feature of these huts was the type of panel used. Each panel comprised a core of "Onazote" insulating material 4 in. (10·1 cm.) thick. "Onazote" is a solid, but extremely light, material resembling a finely frothed or honeycombed bakelite. Glued to each side of this core were sheets of 5-ply bondwood, and the edges were finished in wood. These panels were assembled by bolting them to the frame in such a way as to compress separating strips of rubber, and no cover strips were used.

Experience showed that the "Mark I" hut was not as easy to erect as had been hoped. This was due partly to lack of finish in the construction and the large number of bolts of various sizes to be tightened, but principally to the rubber gaskets being supplied separately. In all succeeding models the rubber gaskets were, during construction, glued to the edges of the panels. Trouble was also experienced in sealing this hut and it was felt that the time involved in erecting the frame might somehow be shortened. Some minor improvements were made during 1950, and early in 1951 huts of this type were erected

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Director, Antarctic Division, Australian Department of External Affairs.

at Heard Island for recreation room, meteorological quarters and seismic laboratory. In 1954 the seismic hut and meteorological hut were dismantled, moved to Mawson, and re-erected, the former being converted into a sleeping hut. No difficulty was experienced.

"Mark II" type

Late in 1951 a "Mark II" form of this hut was evolved. This was well made by a Melbourne firm, Explastics Insulations Pty. Ltd., whose business was the construction of cold rooms and refrigerated storerooms. The firm suggested the simple box-like construction which has since been adopted and manufactured, and two of these huts were erected at Heard Island early in 1952. These were an absolute magnetic hut and a magnetograph hut. Wall, roof and floor panels were again similar and of "Onazote" and plywood construction. However, the frame was dispensed with and the panels were bolted together with brackets fixed on to the outside along the edge of each panel. "Rubazote" gaskets glued to each edge during prefabrication insured adequate sealing and, in addition, cover strips were provided.

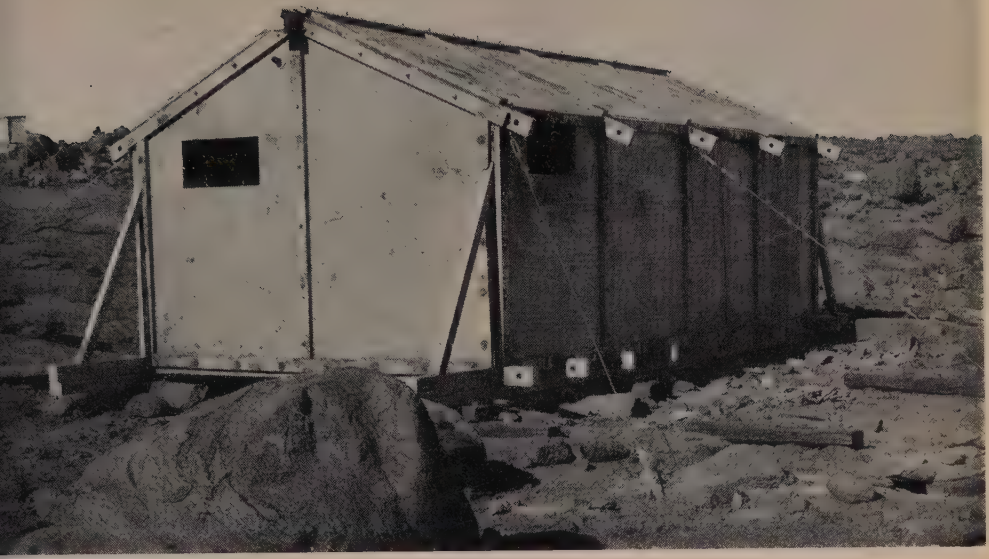
These magnetic huts each took one day to erect and have proved highly satisfactory. They were dismantled early in 1955, transferred to Mawson, and re-erected with very little trouble.

"Mark III" type

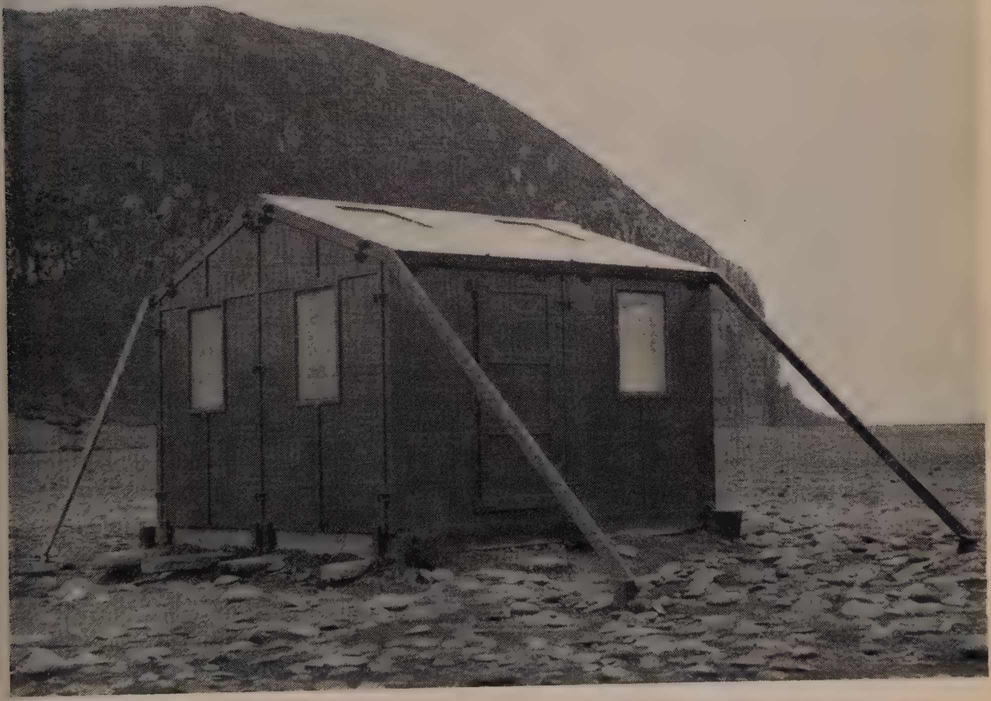
When the question of huts for Mawson arose there was little doubt that this type of hut, with a few modifications, would suit our requirements. A hut was therefore designed to incorporate a radio office, a surveyor-OIC office, a doctor's surgery and a dark-room. Significant modifications included: clamping rods which ran through all panels on any one side and tightened with bolts at the ends (instead of using a number of clamping bolts along each join between any two panels); perspex "box" windows filled with dried air and sealed; entry hatches in the roof; uninsulated "cold porch"; heavy "cold-room" type door with large clamp handles; cheerful colour scheme and carefully designed furnishings; exhaust-fan ventilation and coke-stove heating; aluminium sheathing of outer surfaces to protect against snow blast and to obviate the need for painting. This hut was again very well made by Explastics Insulations Pty. Ltd. At Mawson, one day was spent laying foundations, un-crating panels and setting out the floor. Next day six men completed the hut and it was occupied the same evening.

"Mark IV" type

The increase of the Mawson team in 1955 from ten to fifteen made another sleeping hut essential, and, in spite of rising costs, it was decided to use an "Explastics" hut again. I was more interested this time in the layout of the interior than in the principles of the hut construction itself, which were now well established, and I finally produced a design which stressed economy of space and the individual comfort of the men who were to live in this hut.



'Mark I'

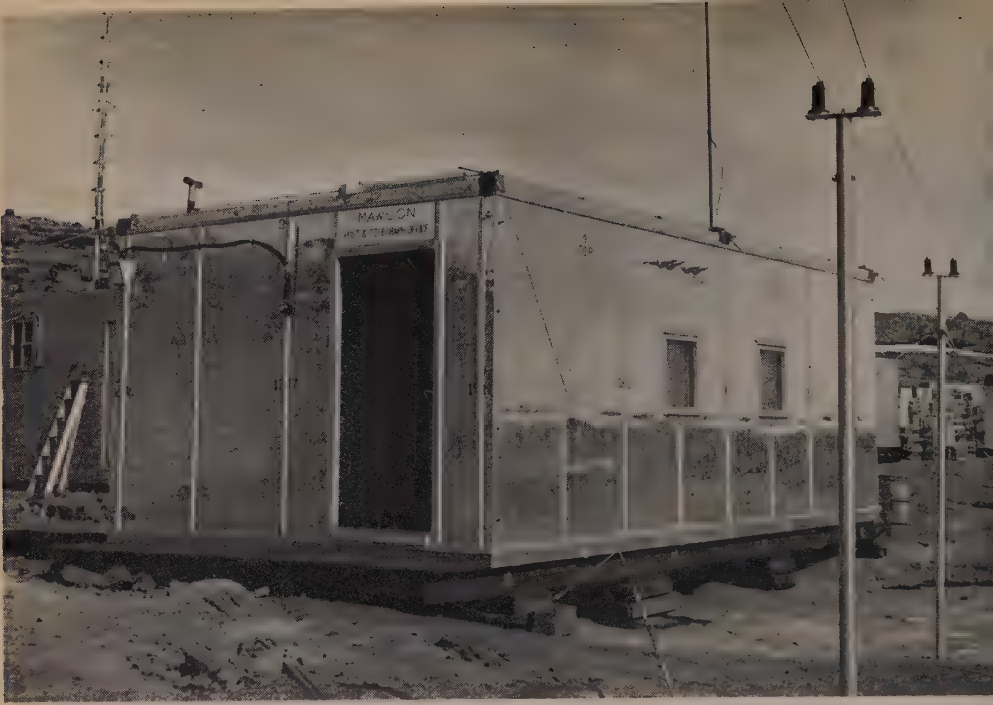


'Mark II'

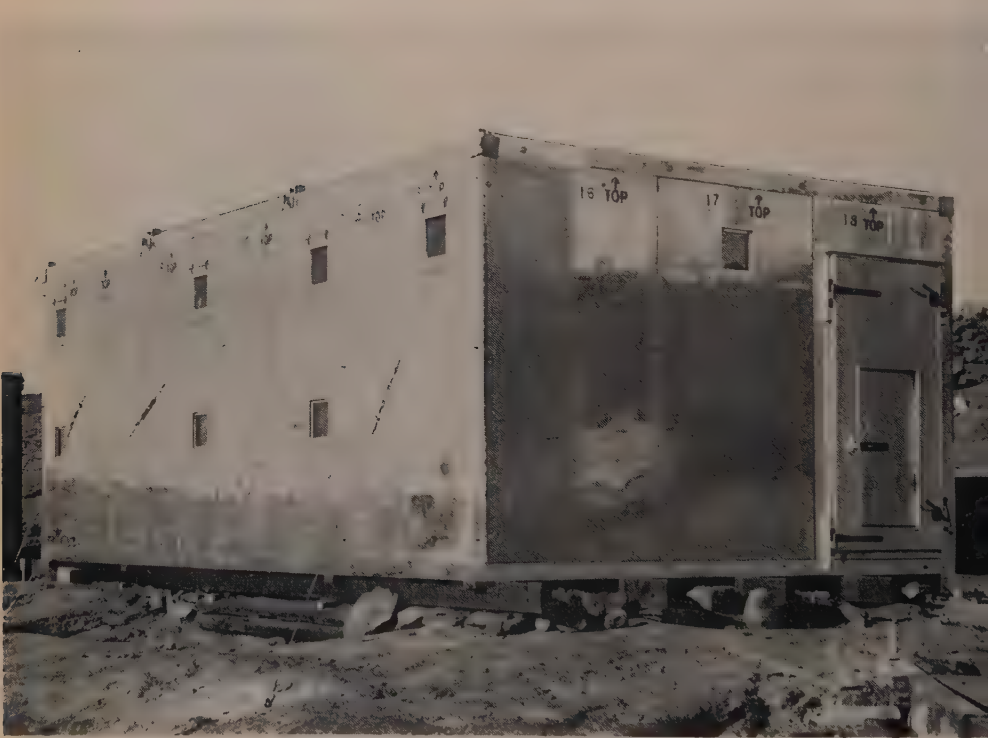
Australian huts for Antarctica

A.N.A.R.E. photograph by Phillip Law

(Facing p. 330)



'Mark III'



'Mark IV'

Australian huts for Antarctica

A.N.A.R.E. photographs by Phillip Law

At Mawson two days were spent laying the foundations and the floor panels. The walls, interior partitions and roof were then raised in one day's work and the hut was securely tied down the same evening. A brief description of this hut follows:

The hut is 27 ft. (8·1 m.) long and 15 ft. (4·5 m.) wide externally and 9 ft. (2·7 m.) high internally. It has a flat roof.

Foundations. The subfloor frame, to which the hut is fixed with metal angles and shoe brackets, is made of creosoted oregon precut bearers and stiffening plates, checked and spiked into the bearers. Bearer ends have holes through which pass steel cables to fix them to the ground.

Walls. External walls consist of fourteen panels, each 9 ft. (2·7 m.) by 5ft. (1·5 m.), and four 9 ft. (2·7 m.) by 3 ft. 1½ in. (1 m.). These panels have oregon framing, with additional framing round all openings. Inside this are two layers of "Onazote", each 2 in. (5 cm.) thick sandwiched between $\frac{3}{16}$ in. (0·6 cm.) thick plywood and 20-gauge aluminium externally, and ¼ in. (0·6 cm.) thick "Asbestolux" internally. The aluminium sheets are glued to the plywood with "Hornex". The clamping rods which run through all panels on any one side of the hut are made of ¼ in. (0·6 cm.) gas tubes which are tightened with bolts screwed over the threaded ends of the tubes. They are also tongued and grooved with "Rubazote" gaskets between. All panel joints are sealed with "Bostik" solution and then, excluding those in the floor, covered with cover straps. The external wall panels internally, and both sides of the internal insulated panels, are secured to the floor, ceiling and at the corners by splayed wooden fillets. The internal panels separating the sleeping quarters from the cold porch are of similar design to the external panels but the insulating "Onazote" is only 1½ in. (3·8 cm.) thick. Other internal walls are constructed of two layers of "Asbestolux", each $\frac{3}{16}$ in. (0·6 cm.) thick, which end 1 ft. (30 cm.) below the ceiling to aid ventilation and heating. Door openings are covered by curtains instead of doors to minimize noise.

Roof and floor. Each of these consists of nine panels 15 ft. (4·5 m.) by 3 ft. (0·9 m.). The floor panels are lined internally with $\frac{5}{16}$ in. (0·7 cm.) plywood, but are otherwise the same as those in the walls.

Special brackets fit on to the roof to facilitate the tying down of the hut. These fit loosely over the roof corners and are clamped down by rods. From them steel wires run, via turnbuckles, to iron pegs grouted with molten sulphur into holes drilled in the rock.

Door. The one external door is of the "door-in-door" type and consists of a small door, 4 ft. (1·2 m.) by 2 ft. (0·6 m.) placed inside a larger one 7 ft. (2·1 m.) by 3 ft. 6 in. (1·1 m.). Both are single, uninsulated, sheeted externally with aluminium, and of the same thickness as the outer wall. The larger door opens outwards and the smaller one inwards. There are two internal doors, single and insulated, leading to the corridor and to the latrine respectively.

Windows. Each sleeping cubicle has two windows, one opening outwards, high up in the wall, and one fixed, lower in the wall. The latrine has one window opening outwards. Windows are of "Polyglass" type "P", and are 1 ft. (30 cm.) square.

Internal arrangements. The external door opens into a cold porch running the width of the hut except for the latrine. Out of it opens a corridor with three sleeping cubicles on each side. Each cubicle contains a bunk, 4 ft. 6 in. (1·4 m.) from the floor and underneath this a desk, chest-of-drawers and hanging space.

Heating. At the far end of the corridor is a cast iron coke stove with a light galvanized iron canopy. A fan, on top of the canopy, forces air, which has been warmed by contact with the stove, into a galvanized iron duct. This divides into two, and each duct bends to return to floor level, then runs along the floor at the back of the cubicles.

Ventilation. The main air inlet is a vertical insulated pipe which leads cold air from beneath the floor and delivers it to a point beside, and level with, the top of the stove. The main air exit is through an annular space surrounding the stove flue, where it passes through the ceiling. Another exit is provided by a hole in the roof at the end farthest from the stove.

Great care has been taken to make the furnishing and colour schemes as attractive as possible.

In 1956 another sleeping hut was built to this design. As the 1955 men had never used the latrine cubicle for that purpose it was dispensed with in the 1956 design, and the space was used for another cubicle. The 1956 hut therefore accommodates seven men instead of six. The escape hatches in the roof were also omitted, as huts do not become snowed in at Mawson. To combat the rising costs, the thickness of "Onazote" insulation was reduced from 4 to 3 in. The price of this hut, including furniture, heating unit, crating, delivery, and a trial erection, was A£4800 (£3840).

I would like to acknowledge the sustained interest and assistance of the Chief Architect of the Commonwealth Department of Works (Mr H. Anderson) and his staff, and the able and efficient work of the firm of Explastics Pty. Ltd., Melbourne.

UNITED STATES BUILDINGS FOR ANTARCTICA

[*MS. provided by U.S. National Committee, International Geophysical Year, 1957–58, and received 10 December 1956.*]

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Introduction

The buildings designed for the United States stations in the Antarctic during the International Geophysical Year are adapted from those at Dundas Air Base and other arctic stations. Those built for "Operation Deepfreeze I", 1955–56 have been further modified for "Operation Deepfreeze II", 1956–57, following experience gained during the winter of 1956.

The size of the standard buildings is 20 ft. (6·1 m.) wide and 48 ft. (14·6 m.) long. They are constructed of prefabricated modular panels 4 ft. (1·2 m.) wide, 8 ft. (2·4 m.) high and 4 in. (10·1 cm.) thick. Special structures requiring additional height for water storage tanks, overhead doors and other facilities are built from panels 12 ft. (3·6 m.) high. The panels are composed of two sheets of plywood separated by framing members. These enclose 3·5 in. (8·8 cm.) of low-density glass wool for insulation. Floor and roof panels for "Operation Deepfreeze II" buildings weigh less than 100 lb. (45·5 kg.) and wall panels about 130 lb. (59 kg.). In 1955 interior surfaces of the wall and roof panels were faced with aluminium sheeting and painted. This was found to be unattractive, so in the buildings designed for "Operation Deepfreeze II" a sheet of aluminium foil is bonded inside the plywood and facing the glass wool. Special types of floor, wall and roof panels have been provided for specific uses.

The floor in the newer buildings is covered with green vinyl.

Foundations

These vary according to whether the building is to be erected on permanent snow or on snow-free rock and soil. In the former case adaptations are made to counteract differential settling of the snow underneath a heated building. The load bearing line of the foundations is extended by steel trusses to 2·5 ft. (0·8 m.) beyond the building, and the weight is further distributed by means of "snow sills" (see Fig.). The area to be used is compacted by means of a roller or with hand tampers. "Snow sills" are then constructed on this surface. Across these are placed wooden bearers, and over the bearers are open-web steel trusses at 4 ft. (1·2 m.) intervals, and cross-braced to trusses on either side. On snow-free sites the bearers are laid directly on the rock and soil. The height of the trusses allows air to circulate under the building, thus reducing the effect of the warm building on the permafrost.

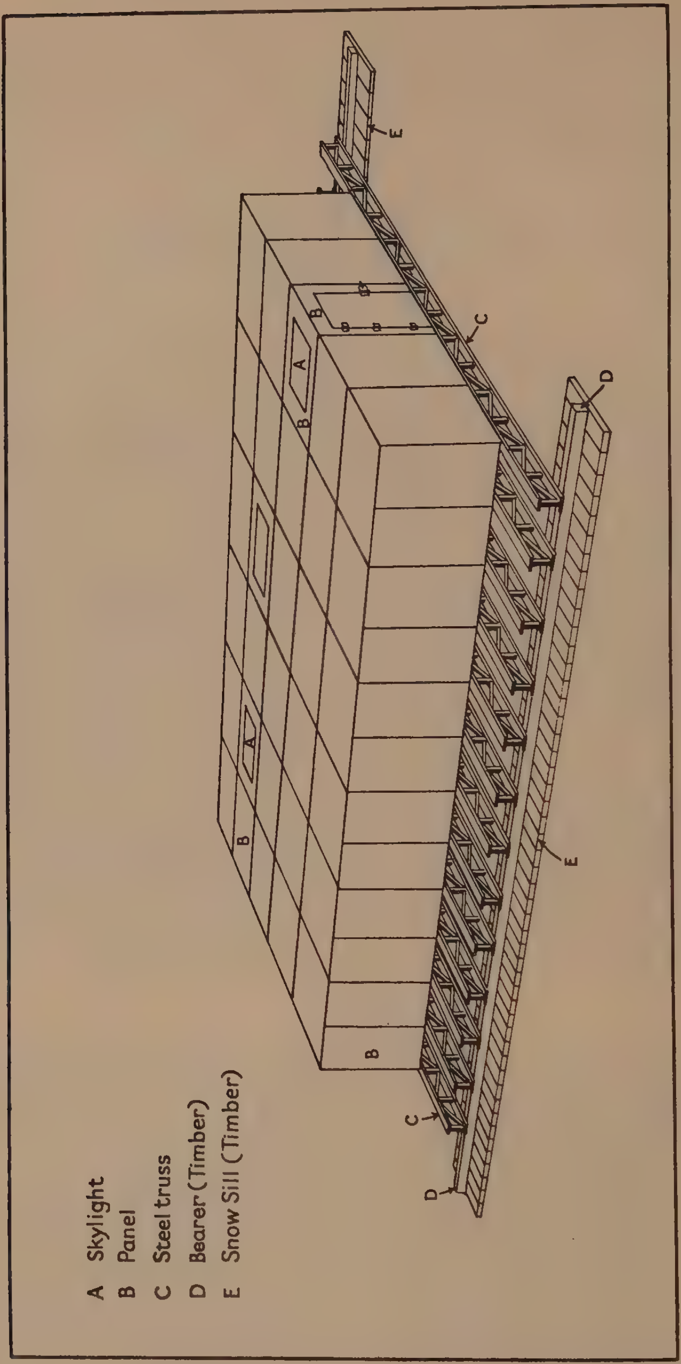

Diagram showing foundations of American hut.

Floor

Floor panels are laid across the trusses with each panel resting on two trusses. The ends and sides of each panel are tongued and grooved together, the tongues being made of hardwood and the grooves lined to insure a close fit. Each panel has a tapered wedge at each end which is secured to the wedge on the adjoining panel by means of metal clips.

Walls

Wall panels are joined in the same way as floor panels. The bottom of each panel has a lined groove to fit a tongue on the upper surface of floor panels around the perimeter of the building. Floor and wall panels are fastened together with two metal clips at the base of each wall panel. Each side wall panel is rebated for a foot at its top edge to support two evenly spaced, open-web, steel roof trusses.

Roof

Roof panels are laid on the roof trusses. They are fastened together and to the wall panels by the same method to form a flat roof. By means of this system no seam between panels runs directly through the building. A caulking compound is then applied to the seams and tarpaulin fitted over the roof, except for skylights and other openings, and battened down to the walls.

Doors

Refrigerator-type outer doors open into a "cold porch" from which an interior door connects with the rest of the hut. Doorways into cubicles are covered with curtains.

Internal arrangements

Floor-to-roof partitions divide the interior of barrack buildings into 3- or 4-man cubicles with central living accommodation. They are also used for the construction of laboratories, offices, kitchens and other facilities.

Ventilation

This is normally provided by the use of two blower fans at either end of each building. The supply fan draws in air from outside and passes it across the ceiling where it is partially heated with rising warmer air. After circulating through the building it is discharged by the exhaust fan at the opposite end. Gravity-type shutters in the walls prevent the entry of wind and snow when the fans are not in use.

Heating

Diesel oil driven "Jet-Heet" furnaces are used to heat buildings in which partitions interrupt an easy flow of heat, e.g. barracks. These furnaces have been used for several years in the joint Canadian-United States weather stations in the Arctic. Air is drawn into the furnace and discharged to wherever it is required by means of a blower unit. Diesel space-heaters, forced air heaters and electric heaters are used when required in particular types of buildings.

Special structures

In addition to these standard buildings, each station will have certain special structures. One of these is the latrine–darkroom–laundry structure. These buildings are constructed of 12 ft. (3·6 m.) wall panels to allow for overhead water-storage tanks. Garage-powerhouse buildings also have 12 ft. walls to accommodate tanks for storing the water supply from snow melters, as well as heavy-duty floors, and wide overhead doors for vehicles.

Each station will have a balloon inflation shelter constructed of 12 ft. (3·6 m.) wall panels. The inflation shelter houses hydrogen-generating equipment for the manufacture of inflation gas, and is provided with an 8 ft. (2·4 m.) by 8 ft. roof hatch through which rawinsonde balloons are released. From a separate small utility building nearby hot air is drawn into the inflation shelter, so reducing the danger of explosion of the inflammable hydrogen from contact with an open flame.

Rawin and aurora towers, intended to elevate certain observation equipment above the level of drifting snow and interference from artificial lighting and surrounding structures, consist of four extensible columns supporting specialized structures. As the snow accumulates in drifts about the buildings of the station, the structures may be raised to a maximum height of 26 ft. (7·9 m.) by extending the telescoping columns supporting them. Access to the structures at the top of the towers is by enclosed ladder-ways.

The rawin tower is capped by a 15 ft. (4·5 m.) diameter fibre-glass dome on a platform. The dome shelters an automatic tracking antenna for rawinsonde instruments.

On the aurora tower is mounted a prefabricated panel building, for aurora observation. On the roof of the aurora building there are three or four 4 ft. (1·2 m.) transparent plexiglass domes for use in photographic, spectrographic and visual auroral studies. With these there is also a 5 ft. (1·5 m.) revolving stainless steel dome with a sliding panel through which pilot balloon observations are made by theodolite.

Other special buildings for scientific work are the geomagnetic absolute and variation buildings at most of the stations. In these structures, built away from the magnetic influences of the other station buildings, metallic materials are non-ferrous, or are eliminated entirely. Also remotely located to avoid sources of man-made interference is a building for "Byrd Station" which houses an antenna and instruments designed to record radio noises from space.

At several stations there will be Quonset huts, semi-cylindrical prefabricated buildings of corrugated steel sheets attached to a series of ribs. These are for workshops and storage space. Another type of semi-cylindrical building is constructed of fabric panels containing insulation enclosed between two layers of impermeable cloth. These buildings will serve as temporary summer quarters at several stations and as shelters at the "Auxiliary Air Operations Facility". The "Little America" station and the "Williams Air Operations Facility" will each have an additional cold-weather building for testing purposes.

At stations erected on permanent snow, the buildings are to be connected by a series of tunnels constructed of wire poultry netting and burlap laid over a framework of timber. Storage areas between buildings are likewise to be enclosed for the protection of caches. At intervals in the tunnels, hatchways will provide exits to the surface by means of ladders, and at the garage entrance a ramp will give access to the outside for vehicles.

THE GOUGH ISLAND SCIENTIFIC SURVEY, 1955–56

BY J. B. HEANEY

[*MS. received 2 October 1956.*]

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Introduction

Gough Island lies in the south Atlantic Ocean about 230 miles (350 km.) south-south-east of Tristan da Cunha. It is a rugged mass of volcanic rock, eight miles long by four wide, rising to nearly 3000 ft. (914 m.).

There had been four brief visits to the island by scientific parties before 1955, but the longest of these had only lasted four days. Many problems presented themselves. Not only was there scope for making the first accurate map of the island and for describing the place, but its isolation in the middle of the South Atlantic presented many interesting questions to biologists.

The Gough Island Scientific Survey planned to spend six months on the island and to examine its fauna, flora, and geology; to set up a pilot meteorological station to test the value of reports for the South African Weather Bureau; and to make an accurate map. It was a private expedition organized in Cambridge, and financial support was given by many bodies interested in the various branches of work to be undertaken. The Royal Navy agreed to take the party of eight from Cape Town to Tristan da Cunha, and from there a fishing vessel of the Tristan da Cunha Development Company was to provide passages for the last 230 miles.

In July 1955 Heaney was advised by doctors not to take part in the field work and he handed over the leadership to Chambers. Heaney's place was taken by Hall, who was to make a film of the party's activities; he was also a partially qualified doctor and a radio operator. Members of the expedition, which sailed in September 1955, were:

J. B. Heaney, Organizer, surveyor, not taking part in early field work
R. J. H. Chambers, Leader, surveyor
M. W. Holdgate, Second-in-command, zoologist
J. P. Hall, Cine-photographer, medical officer
R. W. LeMaitre, Geologist
P. J. Mullock, Radio operator
M. K. Swales, Zoologist
J. J. Van der Merwe, Meteorologist—seconded from the Weather Bureau, Pretoria
N. M. Wace, Botanist

H.M.S. *Magpie* took the party to Tristan da Cunha, which was reached on 1 October.

Gough Island

Gough Island was sighted on 13 November 1955. In 1922 the *Quest* party had reported that there appeared to be only one suitable valley that opened on to a protected beach and also gave access to the interior mountains. Diamond prospectors in 1919 had spent a winter there, and in the last century sealers had established camps in the mouth of this valley, known as The Glen. The island has a north-west south-east trend and is just over eight miles long. The Glen opens out about half way along the more sheltered east coast, and Captain Mohr of *Tristania* confirmed that this was the easiest beach for landing.

During the landing operations Chambers suddenly collapsed with a painful back injury, and was eventually taken back to Tristan da Cunha, and thence to Cape Town. There he recovered but was advised not to return to Gough Island. Holdgate took over the leadership.

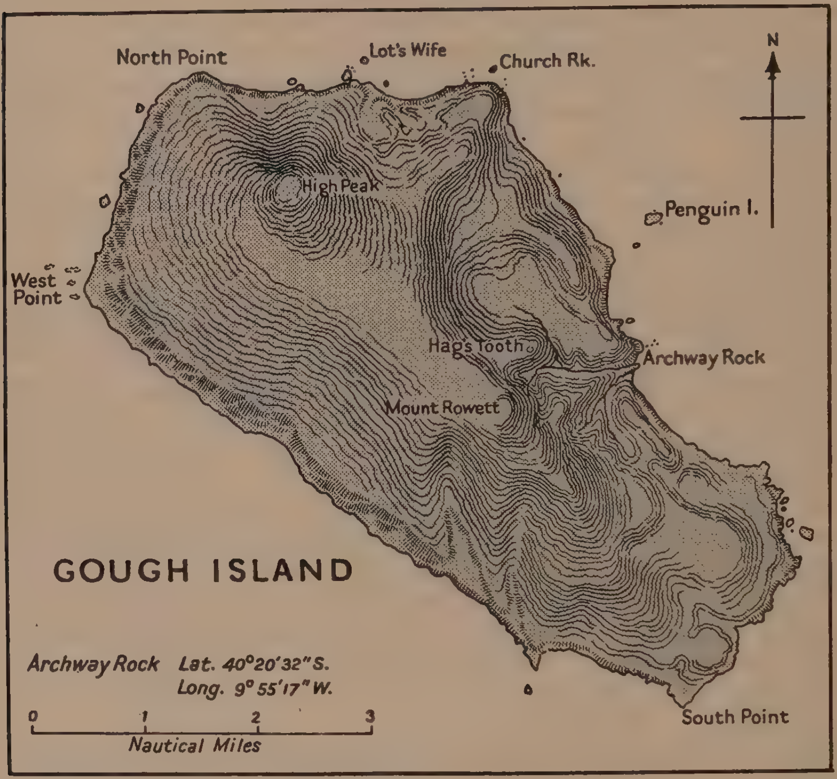
The hut was completed in five days on a site in the narrow mouth of the steep-sided Glen, a few yards from the beach and about 20 ft. (6 m.) above high water. It was a wooden building 36 ft. (10·9 m.) long and 12 ft. (3·6 m.) wide. The prefabricated sections were interchangeable, giving a great flexibility of design, and the final scheme was not decided upon until the hut was actually going up. At one end a living room stretched for three sections, or 18 ft. (5·5 m.). This had double-decker boarded bunks for eight men around three walls, with a line of tables under the windows all along the fourth side. Here the sedentary work of writing notes and drawing maps was done. There was a kitchen-cum-dining room, 12 ft. (3·6 m.) square, with the entrance opening off the living room. Cooking was done on "Valor" oil stoves supplemented with "Monitor" pressure stoves. Two small 6 ft. (1·8 m.) square rooms beyond the kitchen were used as a wireless room and dark room. Two Tristan islanders, Arthur Rogers and John Laverello, who were employed as handy-men, built three additional small huts.

The expedition was without a surveyor after Chambers left, so Holdgate took over the task himself, and learned to use the instruments. Then, at the end of December, Heaney was given medical permission to join the expedition. He flew to Cape Town and was given a passage in the *Frances Repetto*, the second of the two fishing vessels that catch crawfish around the Tristan group of islands. He eventually reached Gough Island on 4 February 1956 and took over the survey programme. He and Holdgate became joint leaders of the expedition.

Physical geography

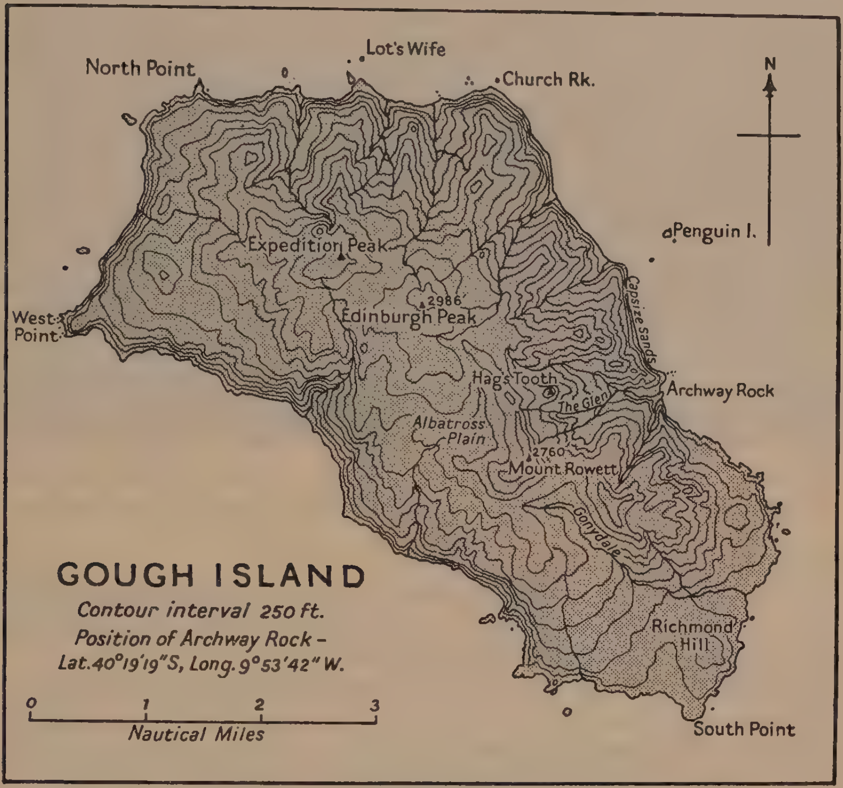
The route to the mountains of the interior led up the Glen stream. The first exploring party had hacked a path through the densely growing tree ferns and island trees (*Phylica arborea*) of the forest zone, which extended up to 1000 ft. (305 m.). In the lower valley the vegetation consists chiefly of a fern-like bracken (*Histiopteris* sp.) which grows about 2 ft high. Higher up the forest becomes thicker. *Phylica arborea* is like an overgrown bush and grows from

10 to 15 ft high. Its branches spread out from ground level and interlace with those of neighbouring trees to form dense thickets. The rock is covered by a layer of perpetually sodden peat which supports all the vegetation, as there is no mineral soil on Gough Island. On steep parts of the path the peat tore away leaving scars of slimy rock, while quagmires formed in the hollows.



Map 1
Surveyed by Shackleton–Rowett Expedition, 1920–22.

Above the forest the vegetation is more open and dominated by a mixture of Crowberry, Wild Celery, grasses and sedges. These are also damp and liable to tear from the hillsides. High up the vegetation gradually becomes thinner, though the peat continues to the tops of all the peaks. The centre of the island is an undulating plateau 2000 ft. (609 m.) above the sea, with lakelets in the yellowish moss that covers the peat bogs. From the plateau named Tarn Moss, the higher peaks rise in gentle slopes to another 500–1000 ft. (153–305 m.). The island's highest summit, named Edinburgh Peak, is 2986 ft. (910·4 m.) above sea-level, and lies a mile and a half north-west of Mount Rowett. Mount Rowett was climbed in 1922 by members of the *Quest* expedition, who fixed its height by aneroid at 2915 ft. (888·7 m.), but its real height is only 2746 ft. (837 m.). At the time of the *Quest's* visit the northern end of the island must have been in cloud because Edinburgh Peak obviously overtops Mount Rowett which they claimed to be the highest summit. In the hollow enclosed by the right-angled ridge of Mount Rowett is a large peat bog of bright yellow and orange mosses that was named Albatross Plain, after the numbers of nesting Wandering Albatrosses that are dotted around its edges.



Map 2
Surveyed by Gough Island Scientific Survey, 1955–56.

Viewing the island from Mount Rowett one sees the marked difference between the west and east sides. The eastern coast is deeply dissected by a series of valleys that cut back through the basalts into the edge of the plateau, while the country to the west rolls down to the tops of the sea cliffs in a succession of rounded ridges and bog-filled hollows. The cliffs, too, are different. On the west they are seldom sheer and can be climbed in most places, while on the east the ascent is always difficult, if not impossible. The southern end of the island is again a contrast. South of Mount Rowett is a broad valley called Gonydale with a meandering stream which spills from the valley into a gorge, and cuts down what the *Quest* party called "easy slopes, well wooded". They are well wooded, and because of this their descent is very difficult. The even gradient levels out at 150 ft. (46 m.) above the sea to an extensive area of wooded lowland. Richmond Hill forms a pommel rising to 700 ft. (214 m.) on the southern edge of the lowland.

Geology

The appearance of the country is directly related to its geology. There have been four major volcanic phases in the island's evolution. First, an eruption of tertiary basalt lava, which was probably responsible for building up the initial cone above the sea. These flows were invaded by a swarm of dykes most of which radiate from Edinburgh Peak, indicating that this might have been the centre of the volcano. Later a violent explosion blew away most of the original cone, leaving only a stump down the present east coast, and this was followed by the extrusion of a large number of flows of trachyte rock. These flowed up against the basalt stump and now occupy the western and southern parts of the island. After a period of quiescence more lavas were poured out, but of basalt again, and they cap Mount Rowett and other peaks with dark horizontal bands. The final phase was a trachyte one, but intrusive this time. Through internal plugs laccoliths were spread out between the flows, and erosion has now exposed some of them as barren domes on which few plants will grow. Hag's Tooth is possibly the stump of a feeding plug after its trachyte umbrella has been eroded off the top. So also are the lower basalts from the craggy ridges and peaks on the east, and, where these give way to trachyte flows in the west, the character of the country changes to one of smooth curves.

Meteorology

A meteorological station was established at the base, 20 ft. (6 m.) above sea-level, and operated continuously from 21 November 1955. The instruments were provided by the South African Weather Bureau.

During the five months December to April inclusive, the mean monthly noon temperatures were 15·2°, 14·6°, 15·4°, 13·9° and 13·7° C., respectively. The highest maximum temperature during the period was 23·7° C. (on 17 February) and the lowest minimum 5·5° C. (25 January). The rainfall totals for the five months were 197·7, 304·5, 152·2, 101·0 and 261·9 mm., while the mean daily sunshine figures were 5·4, 5·5, 4·7, 3·2 and 1·8 hr., respectively. The climate was oceanic, and was dominated by a succession of warm and cold front systems. Orographic cloud was frequent over the island, and standing-wave cloud systems often formed in the lee. Some photographs and notes of these were obtained.

Botany

The vegetation of the island is chiefly composed of plants whose seeds were first brought by wind and birds. The wind easily blows the spores of pteridophytes across and accounts for the high proportion of ferns, and birds carry burrs and hooked seeds on their feathers and feet. The absence of pollinating insects means that there are relatively few flowering plants. Collections immediately revealed that the number of species is extremely small, the provi-

The Glen with expedition's base

Mount Rowett and upland scenery

Gough Island Scientific Survey, 1955–56

Photographs by Gough Island Scientific Survey

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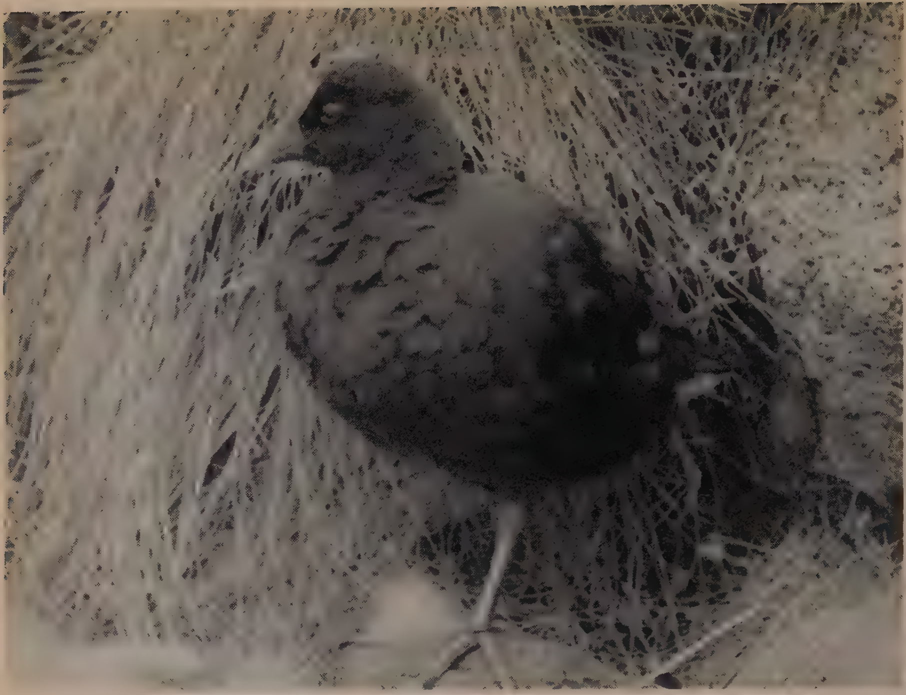

Flightless Rail (*Porphyriornis c. comeri*)

Lowland forest

Gough Island Scientific Survey, 1955–56

Photographs by Gough Island Scientific Survey sional number recognized in the field being 38 angiosperms (of which six are probably of human introduction), 25 pteridophytes, and about 100 bryophytes. Freshwater and marine algae, lichens and fungi were also collected. Wace spent much of his time making borings in the peat bogs to collect material for radio carbon dating.

Zoology

Twenty species of "sea birds", mostly of the order Procellariiformes, and none of them new records, were found to occur on Gough Island. Of these, seventeen species were shown to be nesting, some of them in great abundance. More than a thousand of these birds, including some of all species, were weighed and measured. A study was made of the Wandering Albatross (*Diomedea exulans dabbenena*), a subspecies almost confined in its breeding distribution to Gough Island. The two endemic species of land birds occurred commonly throughout the island and a special study was made of these. The bunting was found to be one species only (*Rowettia g. goughensis*) with five well-marked plumage stages, the youngest a speckled dark brown and the adults green in colour. The rail (*Porphyriornis c. comeri*) has distinct juvenile and adult plumages only (brown and black, respectively). Some live specimens of both species were brought back to England for further study.

More than 10,000 Fur Seals (*Arctocephalus pusillus*) were counted on the island's beaches. They are most abundant on the west coast, which is more storm-beaten and less accessible than the east coast. Estimates made of the composition of the herds indicated 1700 males of six years old and over. The number of seals available for exploitation will be calculated from these figures.

A census was made of the Elephant Seals (*Mirounga leonina*) in the island. The total population is less than 300. In contrast to the Fur Seals, these are found mainly on the east coast on pebble and sand beaches.

About 3000 invertebrate specimens were collected. The terrestrial invertebrate fauna of the island proved to be very poor, and it is unlikely that more than 150 species in all were collected. Many of the species that do occur are, however, very abundant and occupy a wide range of habitats. A few of the insects proved to be apterous or brachypterous, the most striking example of this condition occurring in an upland Lepidopteran superficially resembling the endemic *Dimorphinoctua cunhaensis* of Tristan da Cunha. It is likely that many of the species collected will prove to be endemic.

The littoral fauna was somewhat richer in species, and despite the small tide-range showed some zonation.

The fact that the Fur Seals have turned out not to be the relatively common Cape Fur Seal (*Arctocephalus pusillus*), but the rarer *Arctocephalus gazella* has raised the whole question of conservation and the future of the Gough Island wild life. Since 1948 the Tristan da Cunha Development Company has been exploiting the crawfish, and now it is to start sealing. The South African Weather Bureau has found the reports from Gough Island useful and it has obtained permission to continue the station, at least until the end of the

International Geophysical Year. So civilization has probably come to stay on Gough Island, and the recent Survey was fortunately in time to record the situation today. It will be impossible to prevent the introduction of seeds and invertebrate animals, so the unique quality of Gough Island will soon be lost, but it should not be allowed to suffer the same fate as St Helena, through the large-scale introduction of sheep or goats.

Topographical survey

Holdgate, with assistance from Mullock and LeMaitre, had started the survey programme by doing some triangulation at the north end of the island, and by erecting cairns on all the major peaks. At first it seemed impossible to complete the map in the estimated ten weeks remaining after Heaney's arrival. The country on the east was extremely broken, the weather was a major handicap, and the forest made travelling slow at low altitudes. The climb from the base to the interior took two hours, so it was essential for the surveyors to be on the spot. For this reason permanent camps were set up in the interior: one at the top of the "easy slopes" in Gonydale, and the second at 2000 ft. among the peaks at the north end of the island. A triangulation scheme embracing all the main peaks was worked from these two camps. Provisions were brought up at intervals by the Tristan islanders, and it was necessary to lie out the spells of bad weather in sleeping bags, snatching every short fine spell. The detail of the country was plotted on a plane table using an 80 cm. rangefinder to measure distances. With this absolute method of measuring distances it was found possible to plot from one station all the country visible within a mile radius. On a scale of 1:30,000 contours were interpolated every 250 ft. (72 m.) from a dense control of spot heights.

The coast was largely covered from stations on the shore and on off-lying rocks which were just out of reach of the spray. Offlying rocks formed the best coastal survey stations because they commanded a good view of the shore and it was also possible to resect the position from fixed points in the interior. To reach these stations we used a small 13-ft. dinghy with an islander usually at the oars. This was the islanders' greatest asset; they were masters of small boats and immensely tough. Laverello and Rogers had returned to Tristan da Cunha in January, but two more had come down with Heaney, Ernest Repetto and Harold Green. Often the sea was too rough to land but eventually all the eastern, northern, and southern shores of the island were mapped. The west coast was both out of range from base in a day trip, and a landing was seldom possible on its beaches because of the strong westerly swells. These stretches were mapped from the cliff tops.

Use of wireless

Not only was wireless a great safety factor in the dinghy but it was used in several other ways by the expedition. In the high camps a small "espionage" receiver weighing just over 1 lb. (0.4 kg.) was used to listen to daily broadcasts from the base. The dinghy equipment was an army pattern "62" set which worked off a 12-volt accumulator, and there were also "Walkiephones", as used on Mount Everest. Since these operate on V.H.F. they are only suitable between line-of-sight stations, and were found to get out of adjustment rather easily. The main radio equipment at the base was an outstanding success. There were two transmitters; one a new "Pye" model, a 60-watt H.F. crystal controlled unit, with a crystal controlled receiver in the same cabinet, and the other a "Panda Radio" 120-watt transmitter. Combined with a rhombic aerial system beamed on Cape Town and an "Eddystone" communications receiver, Cape Town Radio was worked regularly twice a day over a distance of 1500 miles, and frequent schedules were kept with Tristan da Cunha Radio and the two fishing vessels.

Conclusion

After Easter the weather began to deteriorate. This seemed to be associated with the annual migration of the weather belts to the north, and the depressions that used to pass south of the island in the summer began to cross north of it. The herald of bad weather became a north-easter which backed to the south-east, instead of rising in the north-west and passing through to the south-west. The Glen beach is exposed to easterly winds, and it was soon obvious why earlier visitors who had been there in the winter had reported such bad conditions for landing.

On 12 May the South African frigate *Transvaal* arrived. The relief party's 30 tons of gear and the expedition's 100 odd cases and many cages of birds for the London Zoo were all transferred in 30 hours. The base was officially handed over to the South African Weather Bureau, who are to operate it as an International Geophysical Year station. Van der Merwe was sworn in as the first magistrate of Gough Island, and he succeeded Mullock as postmaster. He remains for another year in charge of the meteorological station.

On 14 May 1956 the frigate circumnavigated the island making soundings, and at dusk sailed for Tristan da Cunha, just six months and a day after the expedition had first landed on Gough Island.

FIELD WORK

SOVIET HIGH LATITUDE AIR EXPEDITIONS, 1948–56

[From information supplied by V. F. Burkhanov and M. Ye. Ostrekin.]

High latitude air expeditions are becoming an important annual event in the Soviet Arctic. Groups of scientists are transported by air to a number of points on the ice of the Arctic Ocean, and there carry out observations. The basic principle is that knowledge of the area is so slight that even single observations of, for instance, ocean depth, water temperature and salinity, geomagnetic elements, and ice thickness are of value. At the same time the opportunity is taken to establish or relieve the drifting stations. The operation is mounted each spring and normally lasts about six weeks.

The idea of such expeditions stemmed from I. I. Cherevichnyy's flights to the "Pole of inaccessibility" area in 1941. The first to be called a "high latitude air expedition" was in 1948, and thereafter it has probably taken place every year. It is likely that there was an increase in size and scope starting with the 1954 season.

The expedition of 1956 employed thirty-five aircraft and was under the scientific control of M. Ye. Ostrekin, a member of Cherevichnyy's party and now a deputy director of the Arctic Institute [Arkticheskiy Nauchno-Issledovatel'skiy Institut]. About 150 stations were occupied, with a normal maximum time of five hours at each station.

SOVIET OCEANOGRAPHICAL VOYAGES IN THE NORTH PACIFIC OCEAN, 1949–55

[From papers by L. A. Zenkevich in *Izvestiya Akademii Nauk SSSR Seriya Geograficheskaya* [*News of the Academy of Sciences of the U.S.S.R. Geographical Series*], 1956, No. 4, p. 26–37 and by V. G. Bogorov in the same journal, 1956, No. 2, p. 3–5.]

Since 1949 the Institute of Oceanology of the Academy of Sciences of the U.S.S.R. [Institut Okeanologii Akademii Nauk SSSR] has conducted a series of oceanographical voyages in the North Pacific Ocean in its ship *Vityaz'*. The ship, formerly a freighter, has a displacement of 5546 tons and accommodation for sixty scientific workers.

In the seven years 1949–55 the ship has made twenty-two voyages, chiefly in the Bering Sea, the Sea of Okhotsk and the Sea of Japan, but including some voyages farther out into the Pacific east of Japan. A distance of 155,830 nautical miles was steamed and 3558 stations occupied, of which 1582 were geological and about 2000 biological.

The submarine relief of the region east of Kamchatka and Kuril'skiye Ostrova was filled in with much new detail, particular attention being paid to the Kuril-Kamchatka trench. By seismic methods it was found that bottom deposits in the whole area are about 600 m. thick, which gives some support to the view that there was intense volcanic activity here about 100 million years ago.

Photography of the sea bed has been carried out down to depths of 3000 m. Much information on the structure and dynamics of water masses has been obtained by normal sampling techniques.

Biological work has been mainly systematic, with emphasis on the deep wate fauna of the Kuril-Kamchatka trench. Many new species were found at depths o up to 10,000 m. Investigation of the geographical distribution of abyssal fauna confirmed the view that the greater the depth, the greater is the isolation of species.

SOVIET OCEANOGRAPHICAL EXPEDITION, 1955

[From information supplied by L. L. Balakshin.]

The Arctic Institute [Arkticheskiy Nauchno-Issledovatel'skiy Institut] organized an oceanographical expedition in 1955 in the *Fedor Litke* to carry out a hydrographic survey of the region north of Zemlya Frantsa-Iosifa and Spitsbergen. The leader was the oceanographer L. L. Balakshin, and twenty scientists were taken.

The ship left Murmansk on 24 August. For the first fortnight she had the task of towing river lighters to Dikson. This done, she steamed to lat. 82° 05′ N., long. 65° 20′ E., and on 8 September started a series of deep-water hydrological stations, continuing westwards between the 82nd and 83rd parallels. Ice conditions were good, and it was possible to get beyond the continental slope in many places. Zemlya Frantsa-Iosifa was circumnavigated for the first time in an anti-clockwise direction, and on 11 September the ship reached lat. 83° 21′ N., long. 53° 11′ E., which is believed to be the most northerly point reached by a ship under its own power.[1] Many icebergs were encountered.

On 18 September the ship left the area where she was working to refuel at Barentsburg. On 26 September she started work in the waters north of Spitsbergen. On 29 September a depth of 5449 m. was recorded at lat. 82° 23′ N., long. 19° 31′ E. This is the greatest depth yet recorded in the Arctic Ocean. On 12 October the ship again returned to refuel and after a final period of work from 23 to 28 October, returned to the U.S.S.R.

During the cruise, 57 deep-water stations were occupied, 84 bottom samples taken (including one core from 3044 m. depth), and 159 plankton hauls made. Many Polar Bears—about fifty to sixty—were seen in the period of ten days north of Zemlya Frantsa-Iosifa. Radiolarian ooze was found on the seabed at 415 m. depth between Spitsbergen and Zemlya Frantsa-Iosifa.

The full results are to be published by the Arctic Institute in a special volume in 1957.

DANISH SCIENTIFIC WORK ON GREENLAND, 1955

[Summarized from information supplied by Arktisk Institut, Copenhagen.]

West Greenland

Geology. During the months of June to August 1955 fifteen geologists and students worked in the area between Sermiligârssuk and Kobberminebugt. The party was organized by Grønlands Geologiske Undersøgelse and included J. Bondam, E. Bondesen, C. H. Emeleus, S. Bak. Jensen, H. Michelsen, H. Sørensen and B. J. G. Upton. It continued the geological mapping of the southern area of the Frederikshaab district begun in 1954. By the end of the season the preliminary coastal reconnaissance of south-west Greenland was almost completed except for the Julianehaab district.

Glaciology. From June to October Anker Weidick, assisted by five Greenlanders, studied the movement of glaciers in the area between Godthaab and Narssaq. He also supervised the re-establishment of a station at Godthaab for ground temperature measurements.

Botany. F. Terkelsen spent from 3 August to 20 September collecting fungi and macromycetes in the area around Godhavn and Disko.

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[1] These are the corrected co-ordinates and replace those quoted in the Soviet press at the time of the voyage, and reported in the *Polar Record*, Vol. 8, No. 52, 1956, p. 27.

East Greenland

Geology. A party of thirty-five geologists and students, mostly Swiss, spent fro 27 July to 14 September continuing the geological mapping of east Greenland. Th party was led by Lauge Koch, and included H. Bütler, J. Haller, A. Perrenou J. Putallaz and H. Zweifel. It divided into five groups; two in the area betwee Daneborg and Danmarks Havn, and three mainly on Traill Ø and the area west o Staunings Alper. Aircraft were used extensively for transport and photography.

Palaeontology. Two groups from Grønlands Geologiske Undersøgelse party i west Greenland joined Lauge Koch's expedition to study Devonian deposits. On group, led by E. Jarvik, worked on Gauss Halvø and Celsius Bjærg. The other, unde E. Nielsen, worked in the Kap Franklin area. Large and interesting collections o fossils were made by both parties.

Archaeology. An expedition, sponsored by Nationalmuseet and Grønland Geologiske Undersøgelse, continued investigations begun in 1953 on a large midde at Sermermiut in Jakobshavns Isfjord and in the surrounding area. Members wer Professor E. Holtved, Leader, T. Mathiassen, S. Jørgensen, J. Troels-Smith, Fr Troels-Smith, Frøken I. Parbøl and, from Cambridge, A. Sherrif and P. Wordie. Th main party were in the field from 4 July until the end of August. Professor Holtve and Frøken Parbøl remained until 27 September continuing ethnological investigations begun by Nationalmuseet in 1948, in Disko Bugt and the Holsteinsbor district.

Archaeological investigations were also carried out by Eigil Knuth and K. Sørense at a site at Kap Holbæk, near the head of Danmarks Fjord, discovered by Knuth i 1954. The site was 185 km. from "Station Nord" and the two men made the journe on foot pulling a pulka with a load of over 100 kg. The deep soft snow made relay necessary and they estimated that they covered 325 km. in the twenty days of th journey. Further supplies were dropped by United States transport aircraft at thre sites on the side of Danmarks Fjord. After two months at Kap Holbæk Knuth an Sørensen returned by flying boat to "Station Nord" on 19 August.

Zoology. Chr. Vibe has made annual field trips to Greenland since 1948 to stud local fauna. In 1955 he spent from 30 June to 11 July visiting outposts in the Egedesminde district gathering information from hunters on the biology of polar foxe and visiting bird colonies. From 20 July to 11 August he lived with reindeer hunter in Søndre Strømfjord and finally spent a week with Jens Rosing, the Greenlander i charge of the reindeer experiment at Korkut-landet.[1] The herd, introduced fron Norway in 1952, has increased from about 270 to about 700 head.

SCANDINAVIAN ARCHAEOLOGICAL EXPEDITION TO SPITSBERGEN, 1955

[Summarized from information supplied by H. Christiansson and P. Simonsen.]

Between 21 July and 27 August 1955 an expedition, planned by H. Christiansson o Uppsala Universitet, and sponsored by Tromsø Museum, carried out archaeologica excavations at Russekeila, 5 km. east of Kap Linné. The object of the expedition wa to search for evidences of stone-age and medieval settlements, and to investigate th sites of seventeenth- and eighteenth-century whalers' and hunters' camps. The part consisted of three archaeologists, H. Christiansson, Leader, O. Olsen of National museet, Copenhagen, and P. Simonsen of Tromsø Museum; two ethnologists, Pro fessor Tegengren, Åbo Universitet, and G. Nelleman of the Nationalmuseet, Copenhagen, and T. Markusen, a mechanic.

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[1] *Polar Record*, Vol. 8, No. 54, 1956, p. 272–73.

Bad weather hindered and curtailed the programme but, in addition to the main site, excavations were made at Randvika, in Isfjorden, and at Festningen at the mouth of Grønfjorden. Various seventeenth- and eighteenth-century objects were found at these sites.

The dig at Russekeila uncovered the foundations of several terrace houses, two of them wooden, including a bath-house, smithy and store-room. An area of about 200 sq.m. was cleared and four levels were distinguished. Relics discovered showed that the buildings were eighteenth century and of Russian origin. A number of flint fragments were unearthed in a nearby dry river bed.

BRITISH UNIVERSITY ARCTIC EXPEDITIONS, 1955–56

Cambridge Survey in central Vestspitsbergen, 1955

[Note by W. B. Harland.]

C. B. Wilson (geologist) and D. Masson-Smith (surveyor) travelled with the Cambridge Spitsbergen Physiological Expedition, 1955 (*Polar Record*, Vol. 8, No. 54, 1956, p. 253) to Brucebyen and sledged up Nordenskiøldbreen on 16 June 1955. On 23 July they met *Nordsyssel* in Sorgfjorden, when Masson-Smith joined the Oxford University Expedition to Nordaustlandet 1955 (*Polar Record*, Vol. 8, No. 52, 1956, p. 26). Wilson returned to Brucebyen on 26 August after working with the Cambridge North Ny Friesland Expedition, 1955 (*Polar Record*, Vol. 8, No. 53, 1956, p. 154). While in south Ny Friesland Wilson continued previous investigations of the Hecla Hoek around Veteranen, Oslobreen, Backlundtoppen and Malte Brunfjellet, in particular discovering a new fauna in Oslobreen.[1] In spite of bad weather Masson-Smith occupied and reoccupied nine theodolite stations throughout southern Ny Friesland, so consolidating his earlier triangulations of 1949, 1951 and 1953. From this, in addition to obtaining further topographical detail, some forty points were fixed accurately with co-ordinates computed according to the Norwegian grid.

P. F. Friend and B. Moore, members of the Cambridge Spitsbergen Physiological Expedition, 1955, surveyed, topographically and geologically, the area to the west of northern Mittag-Lefflerbreen and southern Austfjorden in continuation of work of the Cambridge Spitsbergen Geological Expedition 1953 (*Polar Record*, Vol. 7, No. 48, 1954, p. 151).

Cambridge University and Marlborough College Expedition to North-east Greenland, 1956

[Summarized from a note by G. T. Wright.]

A party consisting of G. T. Wright and two boys from Marlborough College, N. Biggs and M. Foss, with J. Goodhart and P. Carslake from Cambridge and A. Schiøtz from the University of Copenhagen, visited Loch Fyne to net and ring geese during the late summer of 1956. At Aalesund the party joined the annual Norwegian expeditions led by John Giæver in *Polarbjørn*, and were landed at Hold with hope.

The excessively cold spring and early summer had resulted in a non-breeding year for geese. The party were only able to ring four Barnacle Geese (*Branta leucopsis*). Large numbers of this species and of Pink-footed Geese (*Anser fabalis brachyrhynchus*) were seen in the marshy and lake-studded areas around Badlanddal, at the east end of Moskusoksefjord and in Vestersletten and Östersletten. Some of the party spent five days on Ymers Ø and, both there and farther south at the head of Mountnorris Fjord on Traill Ø, flocks of Barnacle and Pink-footed Geese were seen.

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[1] HARLAND, W. B. and WILSON, C. B. *Geological Magazine*, Vol. 93, No. 4, 1956, p. 265–86.

In order to reach the breeding grounds early enough in the season it would be necessary for an expedition to be flown in from Iceland, and taken on by helicopter from Mesters Vig.

The party was picked up by *Polarbjørn* as she was escorting the salvaged sealer *Jopeter*,[1] and reached Aalesund on 26 August.

The Cambridge Spitsbergen Expedition, 1956

[Note by C. B. Wilson.]

C. B. Wilson (geologist) and D. Masson-Smith (surveyor) left for Ny Friesland in mid-May taking three small boats, and arrived at Longyearbyen by coal-boat on 24 May. A return trip to Akademikerbreen (26 May to 14 June) helped to clarify the stratigraphy and structure of this area. On 20 June they travelled by the *Nordsyssel* to Gråhuken on the north coast. After an accident to his theodolite Masson-Smith sledged across Ny Friesland to Tempelfjorden where, at Sassendalen, he was picked up by the *Lyngen* and returned to England. Wilson remained and did two sledging journeys from Wijdefjorden towards the east coast (via Sørbreen, 29 June to 20 July; and via Tryggvebreen, 31 July to 26 August). During these journeys the Gullfaksebreen-Skinfaksebreen area was geologically surveyed, the fossil collection begun in 1955 in Oslobreen was enlarged, a more thorough collection was made from the Eo-Cambrian tillite, and the general stratigraphy and structure of east central Ny Friesland was further investigated. A sketch survey of Polarisbreen was also completed and some geological observations made in Sørbreen and Nordbreen. Wilson returned to Ny Ålesund on 9 September by small boat, thence by *Nordsyssel* to Longyearbyen and by coal-boat to Norway.

SOVIET DRIFTING STATIONS IN THE ARCTIC OCEAN, 1956

[From *Vodnyy Transport* [*Water Transport*], 5 April, 5 May, 19 June, 4 and 13 September 1956.]

The U.S.S.R. has continued to maintain drifting stations on the ice of the Arctic Ocean.[2] At the beginning of 1956 there were two in operation, SP-4 and SP-5.

Relief is carried out in the spring of each year, at the same time as the annual high latitude air expedition (see p. 346). SP-4 was relieved in the second half of April 1956 by a party under the oceanographer A. G. Dralkin, a member of the first year's party at SP-4 (1954–55). Two of his companions of that time returned with him—M. V. Izvekov and A I. Shutyayev. I. G. Petrov, the glaciologist of SP-2 in 1950–51, is also in the relief party. SP-4 started the year drifting slowly, but gathered speed as it approached the North Pole, which it passed at a distance of 12 km. on 5 July.

SP-5 was relieved on 20 April 1956 by A. L. Sokolov and a party which also includes members of earlier drifting stations—the meteorologists I. M. Sharikov (SP-3, 1954–55) and G. M. Silin (SP-4, 1954–55). It was then at lat. 86° 19′ N., long. 89° E. This station followed, very approximately, the course of drift of the Soviet ship *Sedov* in 1937–40, and the opportunity to make comparable observations was, of course, used. It was hoped that the *Ob'* would be able to relieve the station while she was making an oceanographical voyage in September, but this did not prove possible.

It was decided to set up at the same time a third station, SP-6 (there have not up

[1] *Polar Record*, Vol. 8, No. 53, 1956, p. 179–80.

[2] *Polar Record*, Vol. 7, No. 50, 1955, p. 396–99, and Vol. 8, No. 52, 1956, p. 27–28.

to now been more than two operating simultaneously). This, led by K. A. Sychev, was to have been established close to the point at which SP-2 was evacuated in 1951—about lat. 80° N., long. 160° W. In fact, however, it was set up on an ice island in lat. 74° 24′ N., long. 177° 03′ W. This is the first ice island to have been occupied on a long-term basis by a Soviet party. It measures 14·5 by 11 km.

The work at the stations remains substantially the same: oceanography, meteorology, glaciology and geomagnetism. Great value of course attaches to the continuity of the observations. Certain new lines of study were also initiated. L. Ponomarev, the doctor at SP-4, has been working on acclimatization, and A. Teologov at the same station observed by seismograph small movements of the floe on which the camp was situated.

Priority is given at the Arctic Institute to working up the results of the drifting stations. A number of papers have appeared, principally in *Vestnik Akademii Nauk SSSR* [*Messenger of the Academy of Sciences of the U.S.S.R.*] and *Izvestiya Akademii Nauk SSSR. Seriya Geograficheskaya* [*News of the Academy of Sciences of the U.S.S.R. Geographical Series*].

PLANKTON WORK IN SØRGATTET, SPITSBERGEN, 1956

[Summarized from a note by P. S. B. Digby. A report of previous investigations by P. S. B. Digby was published in the *Polar Record*, Vol. 6, No. 44, 1952, p. 522.]

P. S. B. Digby and his wife, Vi Digby, carried out a programme of marine biological research in Sørgattet, just north of Magdalenefjorden, during the summer of 1956. They were accompanied by Miss Susan Digby, their five-year-old daughter. The object was to investigate the factors controlling the vertical distribution and diurnal migration of zooplankton. The work was a continuation of the plankton studies carried out in Isfjorden, Spitsbergen, in 1948, and in Scoresby Sund, Greenland in 1950–51. The party left England on 27 June and travelled from Tromsø to Longyearbyen in a coal-boat; then on to Sørgattet by *Minna*. They stayed in a hut on Bluffodden, on the south side of Sørgattet. Collections were made by nets towed by a Strandelbarmar boat fitted with a "Seagull" outboard motor.[1] Complementary observations were carried out on the hydrography, light intensity and transparency of the water.

The party was picked up by the *Lyngen* on 28 August and arrived in England on 10 September.

THE WEDDELL SEA CRUISE OF THE ARGENTINE ICE-BREAKER *GENERAL SAN MARTÍN*, 1954–55

[The activities of the Argentine Antarctic Expeditions of 1951–54 were recorded in the *Polar Record*, Vol. 8, No. 53, 1956, p. 160–68. The experience gained during those years led the Argentine Government to consider further expansion of their Antarctic programme, and in June 1953 the construction of an icebreaker was authorized. Details of the new vessel, the *General San Martín*, were given in the *Polar Record*, Vol. 8, No. 52, 1956, p. 47. The following account of the icebreaker's first Antarctic cruise has been prepared by Ena Thomas and is based on Luis R. A. Capurro's *Expedición Argentina al Mar de Weddell* (*Diciembre de 1954 a Enero de 1955*). Buenos Aires, 1955.]

The Argentine icebreaker *General San Martín*, Capitán de Fragata Luis T. de Villalobos, which was launched at Bremerhaven in June 1954, reached Argentina in October of that year in time to take part in the activities of the 1954–55 Antarctic summer season. It had for long been felt by the Argentine Government that their network of Antarctic stations would be much improved by the establishment of an additional station at the head of the Weddell Sea, and this was the main task allotted

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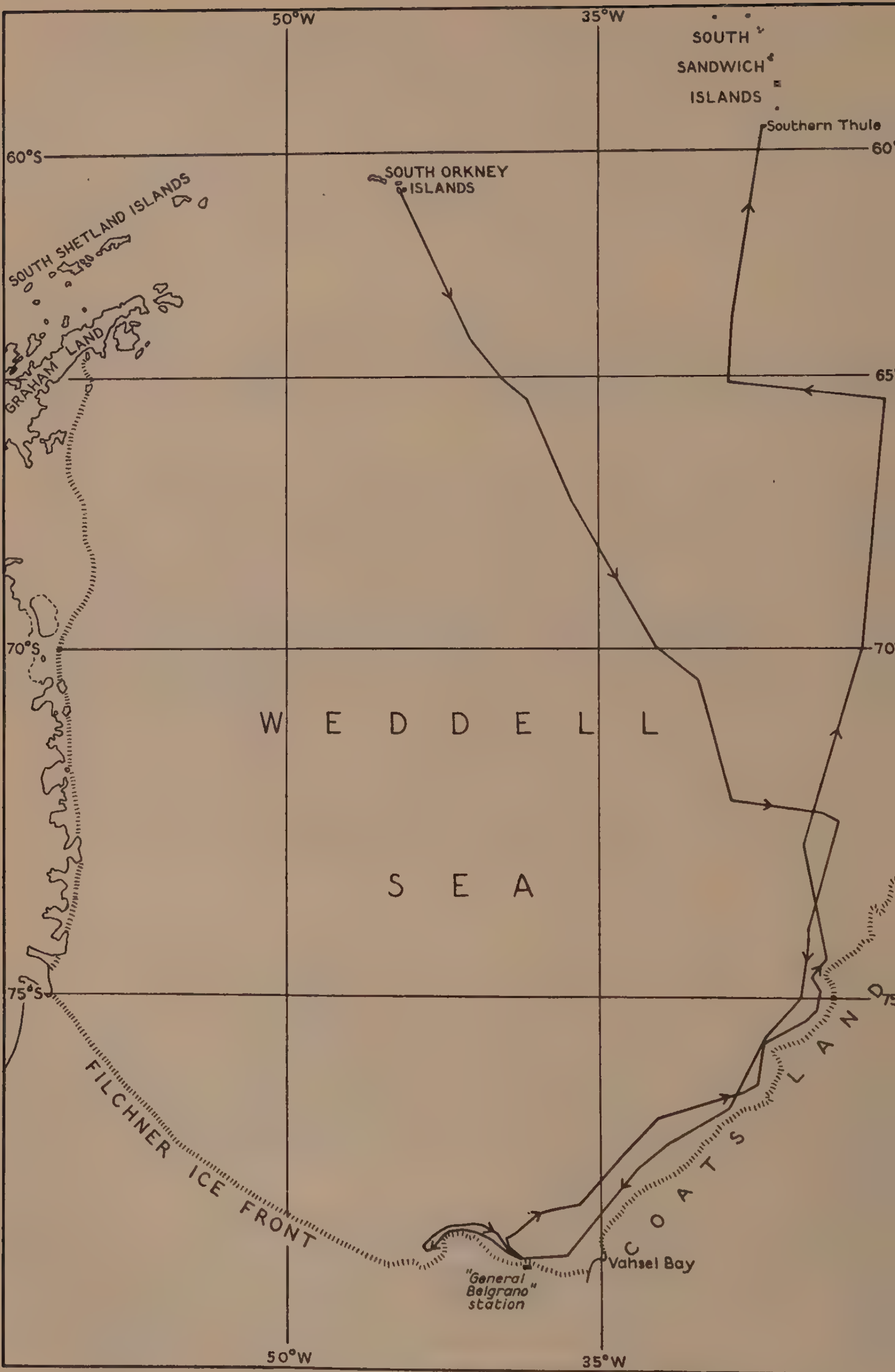
[1] *Polar Record*, Vol. 5, No. 39, 1950, p. 467.



Track of Argentine icebreaker *General San Martín* in the Weddell Sea, 1954–55.

to the *General San Martín* during her first season's operations. The Instituto Antártico Argentino was instructed to assemble the personnel and equipment for the new station; the Chief of Naval Operations was responsible for all naval aspects of the programme.

The *General San Martín* left Buenos Aires on 20 December 1954, carrying the personnel and stores for the new station, and two Sikorsky helicopters. She called at the South Orkney Islands on 25 December and anchored in Scotia Bay, Laurie Island, for two days. On the 27th she departed again for the Weddell Sea. Course was set for the "Stancomb Wills Promontory", reported by Sir Ernest Shackleton in 1915 to lie in about lat. 74° 10′ S., long. 25° W., on the Caird Coast of Coats Land. On 28 December, in about lat. 64° S., long. 41° W., pack ice was first encountered, but the ship was able to continue on her south-easterly course until the 31st when, in about lat. 72° 20′ S., long. 29° W., the ice became thicker and progress was slowed from more than 200 to 100 nautical miles a day. A helicopter reconnaissance indicated better ice conditions to the eastward and course was altered accordingly. On the evening of 1 January 1955, in about lat. 72° 40′ S., long. 24° W., open water was reached and course was again altered, this time to the south-west. Coats Land was sighted the same day and on 3 January the icebreaker moored alongside the fast ice near the eastern end of the Filchner Ice Front, in lat. 77° 58′ S., long. 38° 48′ W.

During the next two weeks 500 tons of stores were unloaded and the new station was set up about three miles inland on the Filchner Ice Shelf. It was named "General Belgrano", and was occupied during 1955 by the following party:

General de División Hernan Pujato, Leader
Teniente 1° Jorge Morganti
Teniente Juan Coelho
Teniente Alberto Maciel
Felix Olmedo Diaz, Medical officer
Sub Oficial Auxiliar Alfonso Obermeier, Aviation mechanic
Sub Oficial Auxiliar Juan J. Naveira, Radio operator
Sub Oficial Auxiliar Domingo E. Molinari, Aviation mechanic
Sargento 1° Americo A. Davila
Sargento Juan B. Carballo
Sargento Julio C. Muñoz, Gunnery mechanic
Cabo 1° Eduardo A. Logares, Sick-berth attendant
Alejandro Cassis, Cook
José R. Correa, Cook

The *General San Martín* left the new station on 18 January for the South Sandwich Islands, sailing in open water along the coast of Coats Land as far as about long. 32° W., where she turned northwards. On 20 January she entered the pack ice and for two days progress was again slowed to about 100 nautical miles a day. More open pack ice was reached on the 22nd, and open water on the 25th.

On the afternoon of that day the icebreaker anchored in Ferguson Bay, Thule Island, and a new refuge hut and navigation beacon were established on the shores of the bay. She left the same evening for the South Orkney Islands. Scotia Bay, Laurie Island, was reached on 28 January and on the 29th she sailed for Hope Bay in northern Trinity Peninsula. On 6 February she left again for Snow Hill Island in the James Ross Island group. There a second new refuge hut was established at the north-eastern end of the island, and the old winter station of the Swedish South Polar Expedition of 1901–03 was visited. This completed her tasks in the Weddell Sea, and she left the area on 7 February.

The *General San Martín* is reported to be equipped with up-to-date navigation equipment, and an oceanographical and a meteorological laboratory, and some scientific work was carried out in the Weddell Sea. A running survey, with the help of radar, was made of the coast of Coats Land between about long. 32° W. and the "General

Belgrano" station, during which it was discovered that Shackleton's "Stancomb Wills Promotory" no longer exists. The echo-sounder was used continuously throughout the voyage, and sea-surface temperatures were regularly recorded. Current measurements were made in the vicinity of the Filchner Ice Front. Hourly meteorological observations were also made in this area, together with some upper air observations. As has been said, the icebreaker's main task was the establishment of the new occupied station on the Filchner Ice Front, and this was successfully achieved.

THE SOUTH GEORGIA SURVEY, 1955–56

[By L. Baume. Notes on the South Georgia Survey of 1951–52, and 1953–54, were published in the *Polar Record*, Vol. 6, No. 46, 1953, p. 807–08 and Vol. 7, No. 50, 1955, p. 403–04.]

The members of the South Georgia Survey, 1955–56 were:

V. D. Carse, Leader and surveyor
L. Baume, Mountaineer
Capt. A. Bomford, R.E., Surveyor
J. Cunningham, Mountaineer
S. Paterson, Surveyor
T. Price, Mountaineer
G. Spenceley, Photographer
K. Warburton, Medical officer

The party left Newcastle on 25 August in the *Southern Opal*, a transport belonging to Chr. Salvesen and Co., and reached Leith Harbour in South Georgia on 24 September. From there they went on to Grytviken.

At the close of the 1953–54 season four major areas of the island still remained to be surveyed: the area north and west of Kohl-Larsen plateau to a line from Sunset Fjord to Wilson Harbour; the area between a line Cape North to Weddell Point westwards to Bird Sound; the area south-west of Salvesen Range between Novosilski Glacier and Drygalski Fjord; and the area south-west of the Allardyce Range between Rocky Bay and Newark Bay.

The first journey in 1955 began from Fortuna Bay on 4 October and lasted for sixty days. Loads weighing about 3000 lb. (1363 kg.) were man-hauled on three Nansen-type sledges. Four two-man ridge tents were used. Sledging rations were packed in 24 man/day boxes weighing 54 lb. (25 kg.) each, and considerable weight was saved by using plastic vacuum packing. The daily food ration, including pemmican or meat-bar, was 28·5 oz. (0·8 kg.) per man and supplied approximately 3000 calories. The protein:fat:carbohydrate ratio was roughly 3:4:5.

During this first journey observations were made, with a Tavistock theodolite, at eighteen stations, mostly on the summits of hitherto unclimbed peaks. At one point a runaway sledge disappeared into the mist but was found only slightly damaged, about 2½ miles away and 1400 ft. lower down. At the head of Grace Glacier the party was struck by a gale of hurricane strength reaching about 110 knots and blowing for sixty hours; two of the tents were badly damaged. The route followed by Shackleton and his party during the crossing of the island from King Haakon Bay to Stromness in 1916 was traced.

The party split into two groups for the second journey which began on 13 December and lasted for thirty days. One group landed at Sunset Fjord, climbed Brunonia Glacier and camped between Ice Fjord and Wilson Harbour. Two survey stations were occupied in this area and others on summits on either side of the col at the head of Brunonia Glacier and the peninsula south of Cape Buller. The second group worked in the Elsehul and Undine Harbour areas.

The third journey began on 28 January 1956. The party crossed Ross Pass and reached Brögger Glacier, where a check base was measured, then relayed their

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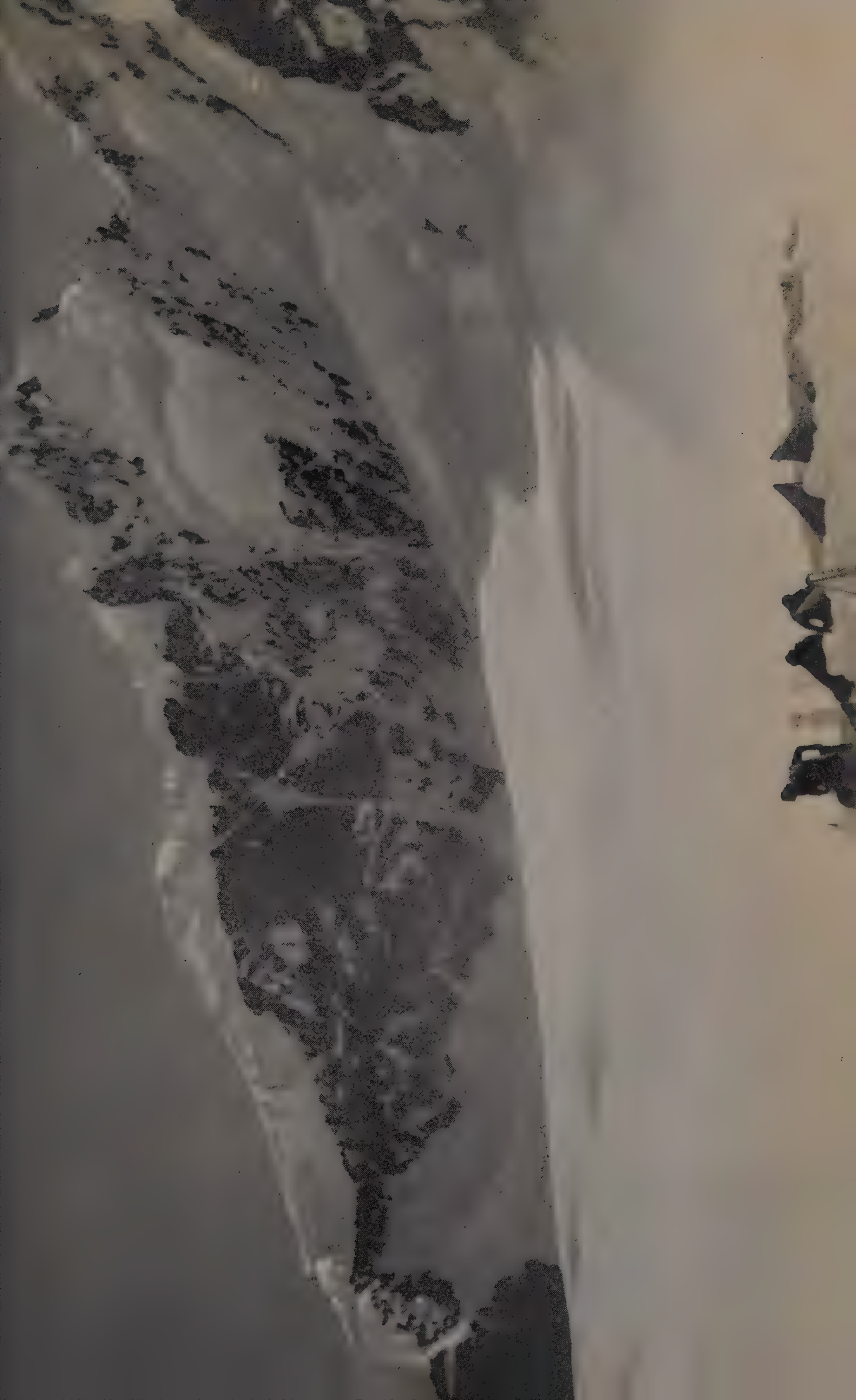
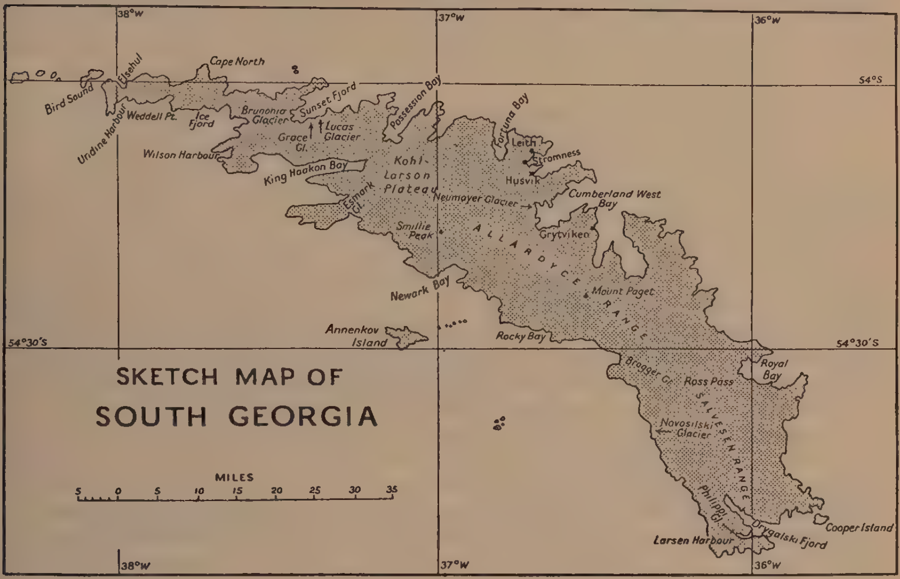
Camp on unnamed glacier flowing into Novosilski Glacier, South Georgia

Photograph by South Georgia Survey, 1955–56



sledges up a tributary glacier over a 4000 ft. (1219 m.) pass on to the Novosilski Glacier basin, and thence down to Drygalski Fjord and Larsen Harbour. During this stretch a "trig" station was observed from the summit of a 7205 ft. (2197 m.) peak, the highest to be climbed in South Georgia. On the summit of the southernmost glacier leading into Drygalski Fjord the party were held up by a blizzard for eight days and just managed to reach Larsen Harbour in time to meet the relief vessel.



The last journey began on 6 March from the snout of Neumayer Glacier in Cumberland West Bay and took the party over rough country and in bad weather to Kohl-Larsen Plateau. There they were halted for two days by storms, and on 14 March they split up into two groups, one to observe a "trig" station on a nearby summit, and the other to move camp towards a 4000 ft. (1219 m.) col beyond Smillie Peak, which they had to cross in order to reach the south-western side of the Allardyce Range. During the afternoon a fierce blizzard arose and the second group, who had pitched camp and gone back to meet the survey group, lost their bearings and spent fifteen hours sheltering in a crevasse, before struggling down to Husvik, about 15 miles away. Two days later the survey party, having given up the remainder for lost, also came down. A party of three returned to the plateau, crossed the col, and completed the survey.

The expedition left South Georgia on 3 April and reached England on 6 May.

The position of the topographical survey of South Georgia is now as follows:

1951–52 and 1953–54 seasons	about 60 per cent surveyed
1955–56 season (new areas)	about 40 per cent surveyed
(re-surveyed)	about 35 per cent

An area of about 5 per cent of the island remains to be surveyed, consisting mainly of short stretches of coastline. V. D. Carse has returned to South Georgia for the

View northwards from summit of unnamed peak (7,205 ft.) in Salvesen Range, South Georgia

Photograph by South Georgia Survey, 1955–56 season 1956–57 to complete this work. Observations made during the 1953–54 season in the south-east of the island have been re-computed in the light of better fixes obtained in the Salvesen Range last season.

Field sheets of the season's work were completed during the homeward voyage and will be revised with the aid of photographs. The sections surveyed during the three seasons have been connected and the island is now completely covered by accurate triangulation, from which a map is to be produced by the Directorate of Colonial Surveys.

THE TRANS-ANTARCTIC EXPEDITION, 1955–58: OPERATIONS IN 1956

[By V. E. Fuchs. Previous accounts of the expedition have appeared in the *Polar Record*, Vol. 8, No. 53, 1956, p. 172, and No. 54, 1956, p. 264–67.]

On 7 February 1956 *Theron* sailed from "Shackleton" (lat. 77° 59′ S., long. 37° 10′ W.) leaving the Advance Party of eight men under the command of K. V. Blaiklock, together with some 350 tons of stores.

Owing to the sudden freezing of the sea *Theron* left nearly two weeks before the intended date. It was not possible, therefore, to begin the building of the living hut, nor could many of the stores be carried up to the base site on the Filchner Ice Shelf, before the ship left. As a temporary shelter a huge crate, in which a "Sno-cat" had been carried, was rebuilt at the base site, and until September served as living quarters for the whole party.

No messages were received from the party until 7 May, when communication was established with the Falkland Islands Dependencies station on Horseshoe Island in west Graham Land, and later with Port Lockroy, both about 1000 miles distant. Transmissions were by W/T, using one of the 10-watt vehicle transmitters. Since then communications have been constant except for occasional "black-outs". In spite of many attempts, no radio contact was made with the Royal Society Antarctic Expedition's base at Halley Bay, only 225 miles north of "Shackleton", until the third week of October.

The first messages received from "Shackleton" stated that, six weeks after the ship had left, a northerly storm broke up the sea ice and carried away many stores which had not yet been transported to the ice shelf. The main losses were: all the coal (25 tons), the prefabricated wooden workshop, a tractor, 240 barrels of liquid fuels and, most serious of all, two tons of chemicals for making hydrogen. The loss of the chemicals meant that the upper air radiosonde programme had to be abandoned.

The building of the main hut continued by lamplight during the winter, and was only abandoned when the temperature dropped below −41·7° C. (−45° F.). At one stage when an unusually strong northerly gale occurred it was entirely filled by wind-packed snow. During the winter the dogs were housed in snow tunnels where the temperature remained constant at −23·4° C. (−10° F.).

The surface meteorological programme began in March and observations are now made every three hours throughout the twenty-four. Since then, mean temperatures have remained below 0° F., and winds have been generally southerly with about 20 per cent from the north, and a very small percentage from other directions. The usual monthly mean wind speed has been about 20 knots.

The hut was completed and occupied on 20 September, and the dogs brought out from the tunnels to begin training.

On 29 September Blaiklock and Goldsmith went on an 80-mile survey journey to Vahsel Bay, returning on 9 October. They reported seeing a few seals and some pups, besides a number of Emperor Penguins.

Activities at the base now include the installation of the main transmitter, the diesel generators, and the erection of rhombic aerial systems. Preparations are also being made for the longer inland reconnaissance journeys to be made when the weather improves.

Three modified "Sno-cats" (Model 743), two additional weasels, a "Bombadier Muskeg", a ski-equipped de Havilland "Otter" and an "Auster" adapted to fly with floats or skis, are to be taken south by the Main Party.

The Main Party of the expedition, which is sharing the *Magga Dan*[1] with the Royal Society Antarctic Expedition, left England on 15 November.

Members of the party are:

V. E. Fuchs, Leader and geologist
D. G. Stratton, Deputy leader and surveyor
Flight-Lieut. G. Haslop, R.A.F., Pilot
H. Lister, Glaciologist
Squadron-leader J. Lewis, R.A.F., Pilot
D. L. Pratt, Transport and engineer officer
G. T. D. Pratt, Geophysicist
Dr A. F. Rogers, Physiologist
J. Stephenson, Geologist, Australian representative
Flight-Sgt. P. Weston, R.A.F., Aircraft mechanic

J. A. Heap, Sea ice investigator of the Falkland Islands Dependencies Survey, D. Milner of the B.B.C., and du Toit, Meteorologist from the South African Weather Bureau, will accompany the party for the 1956–57 summer season only.

Members of the New Zealand party, which leaves New Zealand in H.M.N.Z.S. *Endeavour* (formerly *John Biscoe*), are:

Sir Edmund Hillary, Leader
J. H. Miller, Second-in-Command, surveyor
H. H. Ayres, Dog driver
R. W. Balham, Zoologist
J. G. Bates, Mechanic
Lt. R. Brooke, R.N., Surveyor
R. Carlyon, Surveyor
Sq.-Ldr. J. R. Claydon, R.N.Z.A.F., Pilot
F/O W. J. Cranfield, R.N.Z.A.F., Pilot
M. Ellis, Engineer
J. E. Gawn, Radio operator
J. S. Guiney, Reporter
B. Gunn, Geologist
Dr G. Marsh, Medical Officer
Chief Petty Officer P. D. Mulgrew, R.N., Radio operator
Sgt. L. W. Tarr, R.N.Z.A.F., Aircraft mechanic
P. H. Tate, Cook

INTERNATIONAL GEOPHYSICAL YEAR, 1957–58: ANTARCTICA, 1956

[An account of the advance parties and plans of the nations which are operating in Antarctica during the International Geophysical Year, 1957–58, was published in the *Polar Record*, Vol. 8, No. 53, 1956, p. 182–87. As this number is at press, ships of the eleven nations are on their way south again, and this unprecedented concentration of scientific endeavour is about to begin.

Except for those of the Norwegians and the Japanese, the main stations of all the expeditions have been set up by advance parties. Forward stations are now being established and stocked, scientific instruments installed and tested, and final preparations made for the opening of the full International Geophysical Year programmes on 1 July 1957. The *Polar Record* goes to press in mid-October and the following notes summarize progress and plans reported up to that date.]

Australia

The Australian I.G.Y. programme will be carried out in the existing stations at Macquarie Island (lat. 54° 29′ S., long. 158° 58′ E.) and Mawson (lat. 67° 36′ S., long. 62° 53′ E.) and at a new one to be established early in 1957 in the Vestfold Hills (in approximately lat. 68° 32′ S., long. 77° 55′ E.). The scientific programme at Macquarie Island and Mawson consists of meteorology, geomagnetism, ionospheric and auroral observations, cosmic ray studies and seismology. The aurora will be studied at the station in the Vestfold Hills, glaciological investigations will be carried out from Mawson, and gravity measurements by the expedition's ship and aircraft.

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[1] See p. 373.

Staff at Macquarie Island will consist of an officer-in-charge, four physicists, three meteorologists, a medical officer, a biologist, three radio officers, an engineer and a cook. At Mawson there will be seven physicists, one of whom is also officer-in-charge, three meteorologists, a geologist, medical officer, three radio officers, two engineers, two aircraft pilots and two ground staff and a cook. At Vestfold Hills there will be two meteorologists, one of whom will be officer-in-charge, a geologist, a radio operator and an engineer. There are to be two aircraft at Mawson, a "Beaver" and an "Auster".

France

Occupation of the "Base Dumont d'Urville" at Île des Pétrels was completed by the end of March 1956. On 1 June radio links were reported with Mawson, Îles de Kerguelen, McMurdo Sound, Sydney and "Myrnyy". On 1 October R. Guillard and a party of seven left base to set up "Station Charcot" about 400 km. inland and 100 km. south of the South Magnetic Pole.

The Main Party left Le Havre in the *Norselon*. The vessel carried 300 tons of material and stores, including a light Bell 47 G2 helicopter belonging to the French Air Force.

Members of the Main Party are:

"*Base Dumont d'Urville*"

B. Imbert, Leader, seismology
S. Emery, Deputy leader, oceanography
K. Bulloch, Aurora, radio echo
G. Couly, Vehicle mechanic
G. Coy, Medical officer
J. Daguillon, Aurora
R. Dova, Diesel mechanic
J. Gilbert, Meteorology
M. Grisoni, Geodesy, glaciology
F. Jardel, Engineer-mechanic
J. Lapostolle, Cook
F. Lazarus, Aurora
A. Lebeau, Magnetism
M. Magniez, Meteorology
P. Manuel, Radio
J. Masson, Photography
R. Merle, Radio
M. Plantier, Meteorology
M. Renard, Vehicle mechanic
J. Weill, Aurora

"*Station Charcot*"

J. Dubois, Leader, meteorology
C. Lorius, Glaciology
R. Schlich, Magnetism

A party from the Service Central Hydrographique will make soundings around Pointe Géologie during the summer of 1956–57. They are: Troadee, T. Guivarch and a sailor, Lizeray.

The crew of the helicopter are Capitaine Petitjean and A. Lonegro, pilots, and Jardin and R. Renard, mechanics.

Japan

The Japanese station is to be established on Prins Harald Kyst in Dronning Maud Land. An expedition, led by Professor Takeski Nagata, left Tokyo in the *Soya* early in November 1956 to search for a suitable site, and is to return in April 1957. A wintering party of about ten members may be left if circumstances are favourable, but the main wintering party is to occupy the station from February 1958 to January 1959. The scientific programme comprises aurora and cosmic-ray studies, glaciology, geology, and meteorology and will be carried out from the ship and the shore station.

The *Soya* carries two Bell-470 helicopters, but no other aircraft will be available.

New Zealand

A joint New Zealand/United States station is to be established at Cape Adare, Ross Dependency.

The station will be set up and maintained by the United States, who will also provide all scientific equipment. Three New Zealand scientists will carry out the I.G.Y. programme of ionospheric observations, seismology, geomagnetism, aurora and air glow. A United States meteorologist will contribute to the United States meteorological programme.

In addition to being an I.G.Y. base, Cape Adare station will serve as a meteorological station to provide weather information for United States flights between New Zealand and the Air Operating Facility at Ross Island, and as an emergency air strip in connexion with these flights. An American doctor, four operating staff, and three meteorological observers from the United States Navy will also be on the station.

Norway

A Norwegian expedition has been organized by Norsk Polarinstitutt and leaves Oslo in November 1956 in the sealers *Polarsirkel* and *Polarbjørn*. The expedition is under the leadership of Sigurd Helle and aims to set up a station on the coast of Dronning Maud Land in the region between lats. 70° and 70° 5′ S., longs. 0° and 3° W. and about 50 km. (31 miles) from the ice front. It will be occupied from about January 1957 to January 1959. A subsidiary station near the ice front will be visited from time to time.

The wintering party consists of fourteen men, a geologist, two meteorologists, a glaciologist, a radio officer, and their assistants, a doctor, a mechanic and a cook. The following subjects will be studied: meteorology, ozone, geomagnetism, glaciology, aurora, tides and biology.

A field party, consisting of geodesist, glaciologist, radio operator and mechanic, with two tractors and two dog sledges, will carry out geodetic and topographical work east of "Mayrfjella". This is in continuation of the work done in this area by the Norwegian–British–Swedish Antarctic Expedition, 1949–52.

United Kingdom

During the winter of 1956 the Advance Party at the Royal Society base at Halley Bay have constructed the main hut measuring 130 by 30 ft. (39·6 by 9·1 m.). They have also carried out a pilot scientific programme consisting of surface meteorological observations, measurements of the atmospheric ozone layer, atmospheric electrical noise and auroral photography.

The Main Party of the Royal Society Antarctic Expedition, consisting of about 20 men, sailed from London on 15 November 1956 in the *Magga Dan*, together with the main Party of the Trans-Antarctic Expedition (see p. 356). The scientific programme at the Halley Bay station comprises studies of aurora, geomagnetism, glaciology, gravity, ionospherics, meteorology, ozone, seismology and solar radiation. The following F.I.D.S. stations are to take part in the British I.G.Y. programme: Argentine Islands, Grytviken (South Georgia), Admiralty Bay, Port Lockroy, Hope Bay, Horseshoe Island, Duse Bay, Loubet Coast, Deception Island and Signy Island. The meteorological stations of Stanley in the Falkland Islands, "Shackleton", and "Base 300" of the Trans-Antarctic Expedition will also take part. For its second year the Royal Society Antarctic Expedition is under the leadership of Colonel Robin Smart, R.A.M.C., and the scientific staff consists of: A. Blackie, J. M. C. Burton,

D. T. Tribble and D. G. Ward, meteorologists; L. W. Barclay, W. H. Bellchambers and D. L. M. Cansfield, ionospheric group; Dr G. M. Thomas, aurora; P. M. Brennan and D. B. Harrison, radio echo and scintillation; R. Evans and H. E. G. Dyer, wireless operators; and J. Raymond. In addition there are carpenters, cooks and diesel mechanics.

United States

American plans have been modified as a result of the experience gained during "Operation Deepfreeze" I in 1955–56. The aim is now to complete the establishment of the following six scientific stations during "Operation Deepfreeze II" in 1956–57:

"Little America 5" near Kainan Bay, Ross Ice Shelf (lat. 78° 16′ S., long. 162° 28′ W.), which was established in 1955–56, will be the headquarters of the American activities; it will operate the Weather Central; and the scientific work will include observations on aurora and airglow, cosmic rays, geomagnetism, glaciology, ionospheric physics and meteorology. Ground parties will also explore the Ross Ice Shelf. The scientists will be led by Dr Albert Crary, a geophysicist.

"Byrd Station" in Marie Byrd Land is to be established, if possible in about lat. 80° S., long. 120° W., by overland parties with mechanical transport from "Little America 5". If necessary some supplies will be dropped by air. The scientific work is to include observations on aurora and airglow, geomagnetism, glaciology, ionospheric physics, meteorology and seismology. A ground exploration party will also operate from this station.

"Pole Station" at the South Geographical Pole is to be established entirely by aircraft operating from McMurdo Sound. A small scientific party led by Dr Paul A. Siple will carry out a programme of observations similar to those planned for "Byrd Station".

"Weddell Station" is to be established on the Filchner Ice Shelf. It is hoped to locate it considerably farther west than the existing Trans-Antarctic Expedition base "Shackleton" and the Argentine "General Belgrano" station. The party will be led by Captain Finn Ronne and is the third station which will include a ground exploration team. Observations on aurora and airglow, geomagnetism, glaciology, ionospheric physics and meteorology are also planned.

"Knox Station" is to be established in about lat. 66° S., long. 110° E., near the eastern end of the Knox Coast in Wilkes Land. The scientific party, led by Dr Carl Eklund, will make observations similar to those planned for "Byrd Station".

"Adare Station" in Victoria Land is to be set up, probably in the vicinity of Cape Hallett, about 80 miles south of Cape Adare, and will be manned jointly with New Zealand. In addition to limited scientific observations on aurora and airglow, geomagnetism, ionospheric physics, meteorology and seismology, this station is to have important functions in the air operations and communications, as it lies directly on the flight path between New Zealand and McMurdo Sound.

A seventh station, "Williams Air Operations Facility", which was established at Hut Point, Ross Island, on McMurdo Sound, in 1955–56, will be used primarily as an operational support base for the establishment of the "Pole Station"; for aircraft maintenance and support; and for meteorological observations. Gravity measurements will also be made there during the summer of 1956–57.

This season's activities began with the arrival at McMurdo Sound on 17 and 18 October 1956 of seven aircraft. They flew from Wigram Field, near Christchurch, New Zealand. One of them—a P-2V "Neptune" patrol bomber—crashed on landing, killing three men and injuring five others. The first ships of "Task Force 43" are expected to reach New Zealand about mid-November.

U.S.S.R.

The *Ob'* completed her cruise and returned to Leningrad on 8 July 1956. She had sailed 20,000 miles (32,174 km.) while engaged in oceanographical work in the Southern Ocean under the direction of V. G. Kort.

After the last ship had left on 17 March, the work of building the "Mirnyy" base was continued by the ninety-two winterers. A scientific programme which included meteorological, glaciological, ionospheric, magnetic and seismological observations was started, and a number of flights and overland journeys were made.

In March a party made a short visit by air to Drygalski Island, about 72 km. from "Mirnyy".

An autumn overland journey into the interior of the continent was started on 2 April. M. M. Somov, the leader of the expedition, was in charge, and two S-80 tractors, each towing three sledges, provided transport for eleven men. The intention was to reconnoitre a route towards the projected station "Vostok", which is to be set up at the South Geomagnetic Pole. On reaching lat. 69° 44′ S., long. 95° 30′ E. on 4 May, it was decided to establish a wintering station. Construction materials were flown out from "Mirnyy", and the new station was opened on 27 May and named "Pionerskaya". It is 375 km. (233 miles) from "Mirnyy" and 2700 m. (8856 ft.) above sea-level. A. M. Gusev was left in charge of the four men who manned the station during the winter. Further flights to drop supplies to the new station were made on 7 and 22 June, in darkness; on 7 June one aircraft landed to bring in and pick up personnel. Meteorological and glaciological observations were made. The lowest air temperature at ground-level yet recorded in the Antarctic, −66·8° C. −88·2° F.) was experienced on 20 August.

In the first half of August four parties went out for distances of up to 25 km. (15·4 miles) from "Mirnyy" to make a special study of local winds.

A. F. Treshnikov, leader of the drifting station SP-3 in 1954–55, has been appointed leader of the continental section of the expedition and I. V. Maksimov is to replace V. G. Kort in charge of oceanographical work. M. M. Somov is apparently to retain overall charge, but whether he is to remain in the Antarctic or return to the U.S.S.R. is not clear.

On 15 October a new station was set up 360 km. (224 miles) east of "Mirnyy" in the ice-free area known as "Bunger's Oasis". The station, which was established entirely from the air, is called "Oasis" and its leader is P. Tselishchev.

NOTES

V. A. OBRUCHEV INSTITUTE OF PERMAFROST STUDIES, MOSCOW

[From information supplied by B. B. Roberts and T. E. Armstrong, who visited the Institute in June 1956.]

The V. A. Obruchev Institute of Permafrost Studies [Institut Merzlotovedeniya imeni V. A. Obrucheva] belongs to the Academy of Sciences of the U.S.S.R. [Akademiya Nauk SSSR]. In Moscow the Institute has only an administrative centre and a laboratory which is used solely for the development of new techniques. Most of its work is done at its field stations at Yakutsk (the biggest), Vorkuta, Igarka, Chul'man on the Aldar, and Anadyr'. The Institute has 170 technical and scientific workers and is the only research organization in the country concerned with the scientific aspects of permafrost. There are many others working on the associated practical engineering problems. The Director is P. F. Shvetsov, who succeeded V. A. Obruchev shortly before his death, aged 92, on 19 June 1956.

The Institute has three departments: (*a*) general permafrost studies, (*b*) engineering permafrost studies, and (*c*) laboratory.

The first department (headed by Baranov) carries out surveys of the distribution, development and thickness of permafrost (using electrical prospecting methods successfully for the latter), and works on such topics as the effect of permafrost on surface relief, ground water regime, heat exchange, and vegetation effects.

The second department—permafrost engineering (headed by Saltykov)—studies permafrost in relation to roads, railways, foundations, etc.

The laboratory (headed by N. A. Tsitovich) studies physical and mechanical processes in freezing and thawing, and structure and physical and mechanical properties of frozen soil. The laboratory is housed at Bol'shoy Cherkasskiy Pereulok, dom 2/10, Moscow. It contains small chemical and physical laboratories and a series of cold chambers. The main cold chamber measures about 20 ft. square and is usually maintained at −20° C. Thin sections of frozen soil are examined for general structure. Brinell hardness, shear stress, tensile and compressive stress and creep tests are also routine. There are two smaller chambers maintained at −60°C. These have been built in the basement of a geological institute next door.

In close contact with the Academy's Institute of Geography [Institut Geografii], the Institute has extended its field of study to include work on glaciers, the influence of snow cover on permafrost, and the effects and control of snow drifting.

The publications of the Institute are: *Trudy Instituta Merzlotovedeniya* [*Transactions of the Permafrost Institute*]; *Trudy Yakutskogo Otdeleniya* [*Transactions of the Yakut Branch*]; *Trudy Laboratorii* [*Transactions of the Laboratory*]; *Materialy po Issledovaniyu Merzlykh Gruntov* [*Materials for the Study of Frozen Ground*]; and separate monographs.

Among the scientists now working on the staff is P. A. Shumskiy, a glaciologist and mountaineer who has worked on glaciers in all parts of the Soviet Union, including many Arctic islands such as Ostrov Ushakova, Ostrov Shmidta and the larger island groups; he will be working in the Antarctic with the Soviet I.G.Y. expedition, having spent the southern summer of 1955–56 there on a preliminary visit. He was formerly at the Arctic Research Institute.

RESEARCH INSTITUTE OF AGRICULTURE OF THE FAR NORTH, LENINGRAD

[From information supplied by B. B. Roberts and T. E. Armstrong, who visited the Institute in June 1956.]

The Research Institute of Agriculture of the Far North [Nauchno-Issledovatel'skiy Institut Sel'skogo Khozyaystva Kraynego Severa] belongs to the Ministry of Agriculture of the R.S.F.S.R., and is located at Ulitsa Rakova 17, Leningrad 11.

The Institute has changed its name and allegiance several times. It was founded in 1931 as the Institute of Reindeer Husbandry [Institut Olenevodstva], and from 1935 to 1938 became two of the departments of the Arctic Institute: hunting economics and reindeer breeding. From 1938 until very recently it was the Research Institute of Polar Agriculture, Stock Raising and Hunting Economics [Nauchno-Issledovatel'skiy Institut Polyarnogo Zemledeliya, Zhivotnovodstva i Promyslovogo Khozyaystra]. The Director is Dyachenko, with V. N. Andreyev and V. M. Sdobnikov as his deputies.

The main aim of the Institute is to help the collective farms in the far north (partly by personal instruction, partly by correspondence courses), by provision of information, by training local farm workers, and supplying appropriate seeds and stud animals. Theoretical questions and methods are also studied. The Institute has departments for reindeer husbandry, animal breeding, fur-bearing animals, plant breeding, and the economics of agriculture. About 150 scientific and technical workers are employed, not including some 25 research students [*aspirantura*]. All spend some time in the north each year. The Leningrad office houses 25 workers, and a library of about 30,000 volumes; the rest work at the 24 field stations, located as follows:

Murmansk (reindeer)
Murmashi (agriculture)
Nar'yan-Mar (agriculture)
Salekhard (agriculture)
Nyda (reindeer)
Berezovo (agriculture)
Berezovo (fur-farming)
Khanty-Mansiysk (agriculture)
Dikson (general)
Potapovo (agriculture)
Khatanga (general)
Igarka (agriculture)
Turukhansk (agriculture)
Yartsevo (agriculture)
Tura (general)
Tiksi (agriculture)
Bulun (reindeer)
Verkhoyansk (agriculture)
Bogdarino (reindeer)
Anadyr' (agriculture)
Markovo (agriculture)
Anyuy (general)
Ayan (reindeer)

The main publication is the *Trudy* [*Transactions*]. A *Byulleten' Nauchno-Tekhnicheskoy Informatsii* [*Bulletin of Scientific and Technical Information*] has just been started. Some material is published outside the Institute, e.g. instruction manuals published locally.

The following points concerning the Institute's work were noted:

Reindeer husbandry. Research is carried out on feeding, reindeer products, transport, acclimatization, and general biological questions. Some of the field stations have experimental herds, which are now being enlarged to between 10,000 and 12,000 head per station. The total number of domestic reindeer in the U.S.S.R. was said by the Director by be over two million, but he added there had been no recent count.

Study of diseases and predators continues. The warble fly [*ovod*] is now said to be successfully controlled by a spraying method evolved at the Institute by D. V. Savel'yev. By this method about 2000 animals can be treated in forty minutes. Wolf hunting from slow-flying aircraft with double barrel shot guns is said to have accounted for half the wolves of the European north of the U.S.S.R. This method of control is more effective than any other. The reindeer stations report the presence of wolves by radio and ask for the aircraft to be sent.

Pastures in the north are fully used, but there is room for more reindeer farther south, and these areas are now being investigated. Pasture studies have been the main object of a series of expeditions, under the general guidance of Andreyev, who has devised a system based on air photography and air inspection, followed by spot checks on the ground. He stated that about 80 per cent of the whole reindeer area has now been mapped in this way on 1:100,000 sheets (everything west of the Yenisey and east of Yakutskaya A.S.S.R., including Kamchatka). Experimental transfers of reindeer herds from tundra to taiga have been successful.

Work on selection and breeding is under the direction of I. V. Druri, and is carried out with a special herd of 15,000 head.

Fur-bearing animals. Research subjects are the biology of fur-bearing animals; mainly Arctic Fox (*Alopex lagopus*), Arctic Hares (*Lepus* spp.), various members of the weasel family (*Mustelidae*), Beavers (*Castor* spp.), Musk Rat (*Ondatra zibethica*), and, in mountain areas, six species of Marmot (*Marmota* spp.). The animals farmed in captivity in the far north are the Blue Fox (varieties of *Alopex lagopus*), Mink (*Mustela vison*) and Red Fox (*Vulpes vulpes*). Beavers are not farmed. Trapping methods and acclimatization to new environments are also studied.

Plant breeding. There are two main themes for the work of this department: northward movement of agriculture in order to feed settlements from local sources; and forage crops for domestic animals (mainly cows).

The main vegetable is the potato, which is selected for frost resistance, and can now be grown in soils down to −4° C. Cabbage, tomatoes, carrots, turnips, swedes and onions are also grown successfully in the far north, especially at Dudinka and Igarka. All these are open-ground crops, and are beyond the research stage. Steam-heated greenhouses are also widely used.

Eider Ducks. One member of the staff, Vera Rol'nik, has been studying the life history and breeding biology of Eider Ducks (*Somateria mollissima*), with special reference to the possibilities of domestication and artificial incubation. There is at present no eider-down industry in the U.S.S.R., but it is hoped to develop one.

SOVIET COUNCIL FOR ANTARCTIC INVESTIGATIONS

[*Vestnik Akademii Nauk SSSR* [*Messenger of the Academy of Sciences of the U.S.S.R.*], 1955, No. 11, p. 111.]

A Council for Antarctic Investigations [Sovet po Antarkticheskim Issledovaniyam] has been formed within the Academy of Sciences of the U.S.S.R. [Akademiya Nauk SSSR], replacing an earlier Commission under the interdepartmental committee for the International Geophysical Year.

The work of the new council is to discuss and co-ordinate research for the Soviet Antarctic Expedition, to follow the work as it is being done in the field, and to supervise publication of results.

The chairman is Academician D. I. Shcherbakov, and his deputies are M. M. Somov, V. G. Kort, V. F. Burkhanov, G. I. Golyshev and A. A. Kirpichnikov.

KARELO-FINSKAYA S.S.R.

[From *Pravda*, 17 June 1956.]

The Supreme Soviet of the U.S.S.R. discussed and approved on 16 July 1956 the request of the Supreme Soviet of the Karelo-Finskaya S.S.R. that the latter republic should become in future the Karel'skaya A.S.S.R., forming part of the R.S.F.S.R. The change means that the Karelo-Finskaya republic ceases to be a Union Republic, but reverts to the status (which it held up to 1940) of an Autonomous Republic within the Russian Soviet Federated Soviet Republic, which is the biggest of the Union Republics.

The change is of interest since it represents a step down on the "nationalities ladder". The policy of the Soviet Government is that each national group within the confines of the U.S.S.R. (except those entirely surrounded by Soviet territory) may, according to its growth and its cultural and political development, climb the rungs of the ladder to become a constituent Union Republic.[1]

The reasons given for the change are as follows. The racial composition of the population of the republic has changed since 1940, and now Karelians, Finns and Vepsians account for only about a quarter of the total (the remainder being chiefly Russians). This proportion is likely to get smaller as a further influx of Russian labour is expected. Secondly, economic and cultural ties with the R.S.F.S.R. are emphasized. Economies in administration are expected to result from the change.

It is not easy to see the force of these reasons, since the economic and cultural ties were as strong in 1940 as now, and the proportion of Karelians, Finns and Vepsians has also remained much the same. It is more likely that the reason may be found in the attitude of the U.S.S.R. towards Finland.

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[1] *Polar Record*, Vol. 5, No. 31, 1946, p. 320.

ANGLO-SOVIET FISHERIES AGREEMENT, 1956

[From the official text of the *Fisheries agreement*..., London, Her Majesty's Stationery Office, Cmd. 9778. 1956, and from the *Times*, 26 May 1956.]

A new Anglo-Soviet fisheries agreement was signed in Moscow on 25 May 1956, replacing the temporary agreement signed in 1930, which expired in July 1955. It will come into force when instruments of ratification are exchanged and will run initially for a period of five years from that date.

The agreement permits British fishing boats to approach within three miles of the coast of the U.S.S.R. in specified areas, while other non-Soviet fishing boats must remain outside the twelve-mile limit, which is held by the U.S.S.R. to be the extent of territorial waters.

The specified areas are all in the Barents Sea, and are as follows: off the Murman coast between long. 36° E. and 37° 50′ E.; off the mainland east of Kanin Nos between long. 43° 17′E. and 51° E.; and off the island of Kolguyev. An exchange of notes appended to the agreement states that nothing in it prejudices the claims or views of either government about the limit of territorial waters.

The difference between the new agreement and the old is that British vessels are now excluded from a 100-mile stretch of coast running up to the Norwegian frontier, and from the entrance to the White Sea; on the other hand, they are permitted access for the first time to a 100-mile stretch between long. 48° E. and 51° E., and to the island of Kolguyev, both of which are beyond the eastern limit of the old agreement.

CONSTRUCTION OF ICEBREAKERS IN FINLAND

[From information provided by Wärtsilä-koncernen A/B, Helsinki.]

The Finnish shipbuilding firm of Wärtsilä-koncernen A/B Sandvikens Skeppsdocka, Helsinki, has for some years been the principal centre in the world for construction of icebreakers and ice-strengthened ships.

This firm built the Finnish Government icebreakers *Otso* (1936) and *Sisu* (1938). After the war delivery of ships to the Soviet Union, as reparations and under a trade agreement, included twenty-seven icebreaking steam tugs of 600 i.h.p. from this yard. Two more icebreakers were built for the Finnish Government, *Turso* (1950) and *Voima* (1953). These two are diesel-electric vessels (as is *Sisu* also), and *Voima*, which develops 10,500 s.h.p., has been the prototype of three further icebreakers for the Soviet Union—*Kapitan Belousov* (1954), *Kapitan Voronin* (1955) and *Kapitan Melehov*[1] (1956), and one for the Swedish government, *Oden* (still under construction).

Contracts have been signed for an icebreaker of 7500 s.h.p. for the Finnish Government and for two icebreakers of 22,000 s.h.p. for the Soviet Union. The last two will be for arctic use and will therefore have no forward propellers.

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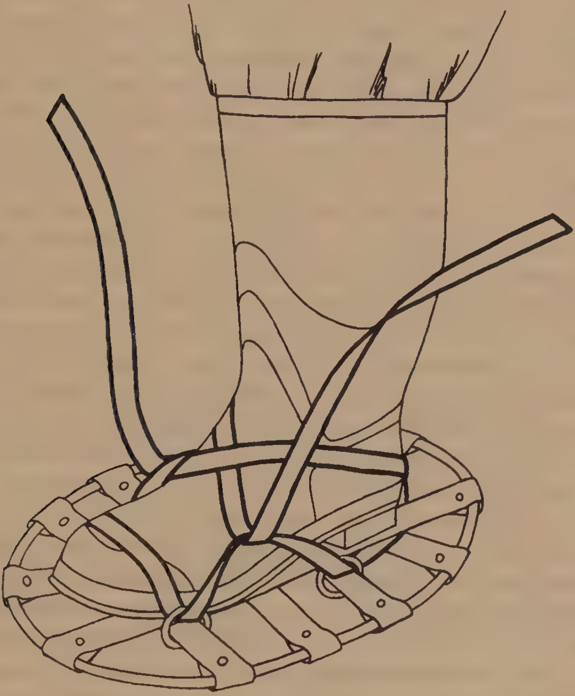
[1] The name is spelt in this way on the ship itself, but the name of the captain after whom she is called is normally spelt Melekhov in English usage.

NEW TYPE OF SWEDISH SNOW SHOE

[Summarized from an article by J.-E. Hansson, U. Sundberg and N. Lundgren in *Skogen*, Årg. 43, Nr. 2, 1956, p. 26–29, and information supplied by J.-E. Hansson and Professor U. Sundberg.]

A series of field trials were held in Norrbotten, north Sweden, in 1955 to compare the qualities of seven types of snow shoes. As a result of these a new type of snow shoe was developed by Statens Skogsforskningsinstitut (State Forestry Research Institute) for use in lumber work. It is smaller than the usual type and is fixed to the heel as well as the toe of the wearer's boot:[1] the larger, free-heel type is more suitable for travelling.



The frame of the new snow shoes is oval and is made of tubular aluminium. It is 38 cm. (15 in.) long and 25 cm. (10 in.) wide. The webbing straps are 2·5 cm. (1·1 in.) wide and are made of 3-ply cord and rubber belting. They are fastened by metal rivets. Leather straps to attach the snow shoe are fixed to the webbing by metal rings. Each snow shoe weighs 0·7 kg. (1·5 lb.).

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[1] A pattern of these snow shoes is at the Scott Polar Research Institute, No. 56/25.

ESTABLISHMENT OF SETTLEMENT AT NEW THULE, GREENLAND

[Summarized from articles by Helge Christensen, Philip Rosendahl and G. P. Rosendahl, and from a note in *Atuagagdliutit/Grønlandsposten*, Nr. 16, 1953, p. 270–71; Nr. 5, 1954, p. 109–21; Nr. 5, 1956, p. 3–6, 22; Nr. 19, 1954, p. 17.]

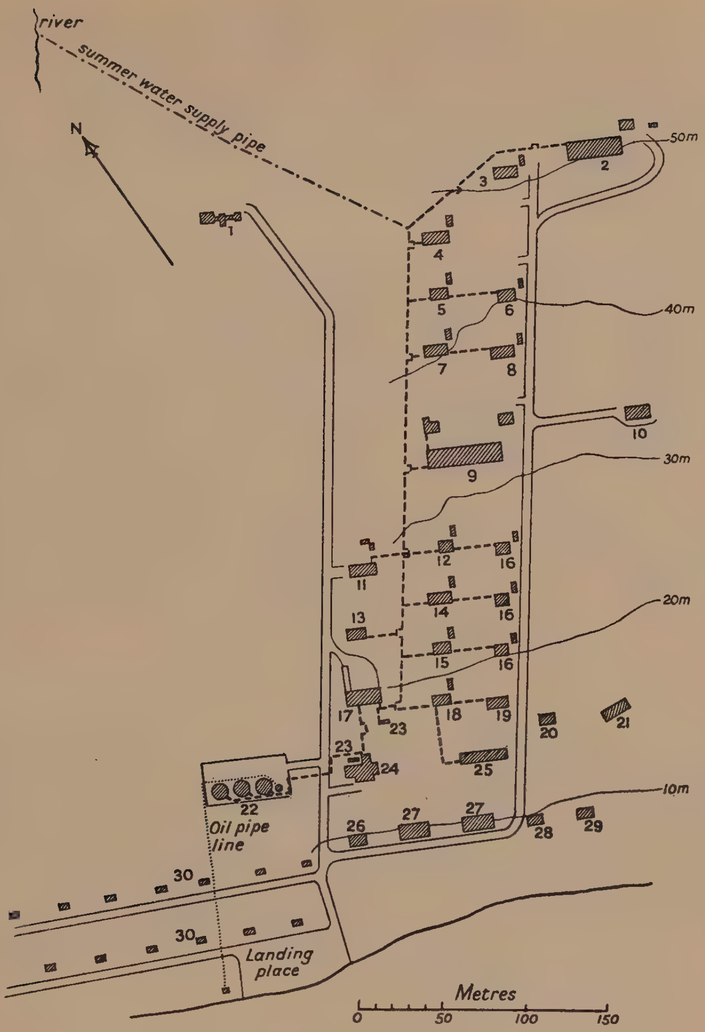
In 1953 the Greenland Eskimo living in Thule decided that they wished to move their settlement to a new site. Their reason was the effect of the nearby United States air-base on their social and economic life, in particular the adverse effect that a large new population, a sudden increase of shipping and the noise of aircraft were having on the hunting. The Danish government agreed to build a house for each family in a new settlement.

The site chosen for the new Thule was at Qanaq, about 100 km. north of the old settlement. It lies on the north side of the mouth of Inglefield Bredning. The district, from Etah to Inglefield Bredning, was already inhabited by about 180 people. While Qanaq was to be the main new settlement, several others were also occupied. All the Greenlanders wished to leave Thule, and between 4 and 7 June 1953 they set off with heavily laden dog sledges on the journey of roughly 160 km.

Qanaq itself was occupied by thirteen families. It has been inhabited at various times before. On the east side there is a large sloping plain with good grass, in the middle a plateau, and on the west a dried-up river bed, where the buildings of the township have been erected. There are good supplies of sand, sandstone and turf for building purposes, on or fairly near the site. There is a river with good drinking water, and glacier ice is always available. The coast consists of an open sandy beach, protected by a large shoal. Parallel to the coast runs a reef, behind which motor boats can anchor at high tide. Hunting fishing and trapping are good in the area. Seven families settled at Qeqertarssuaq, at the eastern end of Herberts Ø, two at Kangerdluarssuk and five at Qeqertat on the east and south of Ingelfield Bredning.

In June 1953 Grønlandsdepartementet's officials inspected the site at Qanaq by helicopter and planned building operations for the summer. On 29 July the *Martin S* arrived from Denmark with labourers and material. There were only six weeks left in which to erect the buildings planned for that summer. The *Sigrid S* and *Etly Danielsen* followed, and were quickly unloaded by means of large pontoons equipped with outboard motors. At the same time the *Kaskelot* left with building materials and labourers for the other settlements.

The first permanent building to be put up was one of the two large warehouses planned for Den Grønlandske Handel. All effort was then concentrated on the hunters' houses. They were built in two rows parallel to the beach, at 25 m. intervals, in order to give space for the dog teams. Four have a floor space of 24·3 sq.m., eight of 18·2 sq.m., and one 13·8 sq.m. They are raised off the ground, and are built of wood, with double insulated walls, roo and floor, and flat roofs. The houses in all the new settlements were ready by 11 September and the workmen returned to Denmark.



Settlement at new Thule.

——road

----supply mains (above ground)

1. Magnetic observatory
2. Hospital
3. Doctor's house
4. Administrator's house
5. Observatory director's house
6. Observatory assistant's house
7. Teacher's house
8. Priest's house
9. Boarding School
10. Church
11. Garage
12. Catechist's house
13. Launderette
14. Electricity works engineer's house
15. Trading company assistant's house
16. Shop assistants' houses
17. Heating plant and water works
18. Electricity works assistant's house
19. Workshop
20. Workers' barrack
21. Canteen
22. Oil storage tanks
23. Oil tanks
24. Electricity works
25. Office and shop building
26. Coal shed and warehouse for skins
27. Warehouses
28. Factor's house
29. Catechist's house (temporary)
30. Hunters' houses

In April 1954 the new settlement at Qanaq was officially renamed Thule, and the old Thule became Dundas.[1] At the end of May fifty-three workmen were flown from Copenhagen to Thule, where they landed on the ice off the coast and were met by the Greenlanders with their dog sledges. At the end of July, when the ice moved out, the *Nancie S* and *Alca* arrived with material and workmen, bringing the labour force up to 190 men. The building programme at Thule was resumed.

The buildings are erected on the sloping stone bed of the dried up river, facing Inglefield Bredning. All except the warehouses are prefabricated, with joints between units caulked and sprayed with plastic. They have triple windows. A system of oil-burning "district" heating was chosen as being the most economical. Pipes run in insulated supply mains above ground from the heating plant to all the buildings except the church, which is electrically heated. The water works is attached to the heating centre. During the summer it obtains its water supply from the neighbouring river, but for the rest of the year ice is melted by means of the electricity works' diesel engines. After being purified, the water is carried by insulated pipes lying in the same mains as the heating pipes. The houses are equipped with electric light and power, and washing facilities. There is a central launderette, and two Finnish baths are provided for the community at the school. Waste pipes are protected from freezing by electrically heated cables. Oil containers have been built large enough (1800 cu.m.) to contain two years' supply.

Despite mishaps the settlement was completed as planned. The reef caused delays as in the previous year, and when the *Jutho* arrived in the middle of September with the first oil cargo, it was found that an iceberg, settling at low tide, had broken the pipe line laid on the bed of the sea. The *Alca* sailed in the middle of September with the main body of the labour force. The remainder were flown from Thule on 23 November by aircraft using the ice as a landing strip. A small number returned in 1955 to complete the scheme.

During August and September 1954 the administrator, doctor, nurses, teacher, priest and traders arrived, and the new settlement was fully established by the end of the next summer.

NEW ESKIMO SETTLEMENT AT RESOLUTE BAY, NORTH-WEST TERRITORIES

[Summarized from information provided by J. F. Richards, Arctic Division, Department of Northern Affairs and National Resources, Canada.]

During the past three years the Department of Northern Affairs and National Resources has encouraged and assisted groups of Eskimo to move from areas where they were finding difficulty in making an adequate living to other areas where hunting and trapping conditions were more favourable, and where there are opportunities for steady employment.

One of these projects was started in the summer of 1953 when four families three from Port Harrison, Quebec, and one from Pond Inlet, Baffin Island, were voluntarily transferred to Resolute Bay. There is evidence from archaeological sites that Eskimo formerly lived in this area, but it appears that this has not been within the past 300 years. The project was regarded as an experiment to determine how Eskimo from southern areas can adapt themselves to conditions in high latitudes. The Eskimo, together with their dogs, boats and other belongings, were carried free on *C. D. Howe*, during her annual cruise in eastern arctic waters.

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[1] See *Polar Record* Vol. 8, No. 53, 1956, p. 176–77.

The group settled near the air base at Resolute and were placed under the supervision of the R.C.M. Police detachment there. The experiment has proved extremely successful. Eskimo have been able to get all the game they need and sufficient fur, and other produce, to barter for their other requirements. The men, many with a natural aptitude for mechanics, have easily found employment during the summer in the annual sea and air supply operations. For the rest of the year they hunt and trap, thus insuring a reasonable standard of living.

Six more families joined this group in 1955, bringing the Eskimo population of Resolute Bay to fifty-four. It seems probable that similar colonies will be established at other centres in the far north, to the benefit of the Eskimo themselves and the development of these areas.

CARIBOU INVESTIGATIONS IN THE CANADIAN ARCTIC,

1953–56

[Based on an article by A. W. F. Banfield in the *Beaver*, Outfit 286, 1956, p. 3–7 and on an unpublished report by A. W. F. Banfield and J. P. Kelsall entitled *Barren-ground Caribou Populations and Utilization, Winter, 1955–56.* Notes on the investigations in 1948–50 were published in the *Polar Record,* Vol. 6, No. 42, 1951, p. 253–55, and No. 44, 1952, p. 532–33.]

The results of the caribou investigations in the Canadian Arctic in 1948–50 showed that the population between Hudson Bay and Mackenzie River was then about 670,000 head. This figure was taken to represent a reduction of 62 per cent on the estimated population in 1900.

Following these investigations, J. P. Kelsall of the Canadian Wildlife Service was stationed at Yellowknife in 1950. There he undertook more detailed studies of the breeding habits and food requirements of herds in the area. Additional surveys were carried out in other parts of Canada during the next two years. In 1953 a survey of the northern Yukon Territory herd was made, in co-operation with the U.S. Fish and Wildlife Service, and indicated a population of about 30,000 head north of the Ogilvie Mountains. An air survey of Baffin Island in 1954 indicated a population of about 5000 head, and, in the same year, a figure of 5000 was estimated in Ungava peninsula.

During the spring of 1955 a detailed re-survey of the central area (the districts of Mackenzie, Keewatin and Saskatchewan) was made. This was a greater area than was covered in the original survey. Most of the total range of caribou between Hudson Bay and Mackenzie River was covered in strips fifteen to twenty miles apart. The flight tracks crossed the direction of migration, so it is unlikely that any significantly large herd was missed.

The results of the re-survey were alarming. Only about 39,000 caribou were observed (compared with the 350,000 which were observed during the 1948–50 survey), giving a new estimated total of about 277,000 head. This represents a decline of about 60 per cent during the last six years. The decline has been greatest in the district of Mackenzie.

Four factors are held to be responsible for this rapid decrease: poor calf-crops, disease, predation and human utilization. There are known to have been some poor calf-crops since 1950, falling in 1950 and 1951 to as low as 7–9 per cent. The calf-crop of 1952 was unusually high at 28 per cent, but this was not sufficient to offset earlier losses.

There have been no reports of significant losses by disease. A strange trek of Banks Island caribou to the mainland during the winter of 1952–53 is still unexplained. Small herds were reported to have crossed the seventy-five-mile frozen strait to die along the mainland shore. The high mortality and scarcity of fawns suggest a failure of food supply, but there is no evidence of this on the winter ranges.

The toll of the herds taken by wolves is considered to be comparatively slight, and control is rapidly reducing their number.

Certainly the main cause of the decline of caribou herds is human utilization. Figures over the whole area are not available, but an isolated instance comes from Keewatin and Manitoba where, during the winter of 1954–55, the native kill amounted to 12 per cent of the estimated population. At the same time the calf-crop was 13 per cent. Losses from predation, disease and accident were responsible for an estimated decrease of 9 per cent in the herds. In the Snowdrift area of the district of Mackenzie Indian hunters are considered to have reduced one herd from 5000 to 2300 in a single season's hunting.

In February 1956 a survey was carried out over Saskatchewan by two aircraft in 50 hours flying time. In the district of Mackenzie 18,000 survey miles were flown during March and April. J. H. Kelsall was in charge of operations in both areas. Again population figures showed distressing decreases. In the district of Mackenzie wintering caribou numbered 80,900 where in the previous winter the estimated number was 96,900. The calf-crop in 1955 in both districts was only 7·9 per cent, and nothing less than 20 per cent can be considered large enough to balance normal decreases.

The Inter-departmental Caribou Conservation Committee, at their meeting in Vancouver in June 1956, made certain recommendations in connexion with the caribou situation which, it is hoped, may stem this decrease. These are unlikely, however, to have any appreciable effect without the understanding and co-operation of native hunters.

THE BERING SEA PATROL

[Summarized from a note provided by United States Coast Guard.]

The Bering Sea Patrol was officially established in 1895 by the United State Marine, the forerunner of the United States Coast Guard. Revenue cutter had, however, patrolled the Bering Sea since the *Lincoln* arrived at Sitka in 1867, the year in which Alaska was purchased from Russia.

Almost immediately after the transfer of the territory, legislation was passed to protect the sealing industry, which drew boats from several nations to the sealing grounds in the Pribilof Islands, and was threatened with extinction from over-exploitation. Similarly, beginning in 1889, the whaling, salmon and other fishing industries in Alaskan waters gradually came under government control. The enforcement of these laws has remained one of the main functions of the Patrol.

In the early days, however, the cutters performed many more duties. They sounded, charted and prepared sailing directions for the waters of the Bering Sea. Their captains were supreme authorities in the American Arctic from Nome to Point Barrow, and are still United States Commissioners. They performed the offices of most government departments: agriculture, judiciary, police, post office and survey. As the territorial administration developed, many of these functions were taken over by the departments concerned, but the Patrol cutters still represent the only connexion with government at many isolated settlements in the Arctic.

One of the best-known cutters was the *Bear*, which served on the Patrol for forty-one years. In the winter of 1897 she went to the help of eight whaling ships beset near Point Barrow. She sailed as far as possible; then sent a party on foot across the ice driving a herd of 400 reindeer for food. The journey took from 17 December to 29 March 1898. Then, for four months, the party kept order among, and fed, over 270 sailors and 500 natives, until the *Bear* broke through in July.

In the years before the Second World War the Patrol consisted of eight to ten cutters with headquarters at Unalaska. By 1955, however, the patrol was carried out by one cutter only, the *Klamath*. The Patrol is in the jurisdiction of the 17th Coast Guard District which covers Alaskan territorial waters. The annual cruise of some 7000 miles takes three months. In addition to normal coast-guard duties, medical and dental services are carried to Alaskan natives, and law is enforced in the remoter centres.

DANISH POLAR TRANSPORT VESSEL, *MAGGA DAN*

[Summarized from information provided by J. Lauritzen Lines.]

The motor vessel *Magga Dan* was built by J. Lauritzen Lines of Copenhagen for service as a powerful cargo vessel in both Arctic and Antarctic waters. She was launched on 1 June, and will be used jointly by the Trans-Antarctic Expedition and the Royal Society for the relief of their Antarctic bases in the course of the 1956–57 season.

This vessel is larger and more powerful than *Kista Dan*.[1] She has a deadweight tonnage of 1650 tons, and a gross tonnage of 2100 tons. She has an overall length of 245 ft. (74·7 m.), a moulded breadth of 45 ft. (13·7 m.) and a draft as a passenger vessel of 10 ft. 8 in. (3·2 m.). The hull, shaped with a raked forefoot, has framing 12 in. (30·5 cm.) apart throughout, and is plated with 1 in. (2·5 cm.) steel up to the load line. Fins and an "ice knife" protect the propeller and rudder from damage by ice. The cargo capacity of 63,000 cu.ft. (1784·2 cu.m.) is insulated and may be refrigerated for passages through the tropics or for conversion to normal commercial use for carrying fruit, meat, or fish. There is accommodation for 35 passengers and a crew of 26. As an aid to navigation in ice the ship may be completely controlled from a fully equipped and enclosed crow's nest.

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[1] *Polar Record*, Vol. 6, No. 45, 1953, p. 688.

The vessel is powered by a direct, reversible, single acting two stroke, 7-cylinder diesel motor which develops 2060 i.h.p. at 300 r.p.m., and is coupled with a variable pitch propeller. The power unit is built by Burmeister and Wain. She has a range of 16,000 miles at a service speed of 11·75 knots.

ROYAL RESEARCH SHIP, *JOHN BISCOE*

[Summarized from information provided by the Colonial Office Information Department.]

The R.R.S. *John Biscoe*, built in Paisley by Fleming and Ferguson Ltd., was launched on 11 June 1956, and was ready in time to help with the relief of Falkland Islands Dependencies Survey bases in the 1956–57 season. Her predecessor, of the same name, which served F.I.D.S. from 1947 to 1956, has recently been purchased by the New Zealand Ross Sea Committee for use by the Trans-Antarctic Expedition. She has been renamed H.M.N.Z.S. *Endeavour*.

The present *John Biscoe*, with a loaded displacement tonnage of 2250 tons, is 220 ft. (67·1 m.) overall, has a moulded breadth of 40 ft. (12·2 m.) and draft of 16 ft. (4·8 m.). She is designed with a raked forefoot; there are also fins and an "ice knife" to protect the propeller and rudder from damage by ice. The main frames are 24 in. (61 cm.) apart but the intermediate framing has increased the strength of the hull. The plating, of "Coltuf 28" steel, is 1 in. (2·5 cm.) thick for a distance of 40 ft. (12·2 m.) from the bows, while the remainder is covered in ¾ in. (1·9 cm.) plating. She has a cargo capacity of 27,750 cu.ft. (705·9 cu.m.) and has accommodation for 34 passengers and a crew of 33. She is equipped with a partly enclosed crow's nest.

The vessel is propelled by a single manganese bronze screw directly coupled to a double-armature motor, capable of developing 1350 to 1450 s.h.p. at 175–180 r.p.m. The power is supplied by two main diesel generating sets, of General Electric Company design, connected in series. The ship has a range of 20,000 miles at the service speed of 12 knots.

CORRESPONDENCE

POSTAL SERVICE IN SOUTH GEORGIA

The *Polar Record* for May 1956 publishes the full text of the Application by the Government of the United Kingdom to the International Court of Justice at the Hague on 4 May 1955 relative to the encroachments of the Government of Argentina in British Antarctic Territory. In para. 20 (i) it is stated that a post office was established at Grytviken in 1912 (*Polar Record*, Vol. 8, No. 53, 1956, p. 134). Actually this took place in 1909, for according to the *Annual Colonial Report* for that year "A post-office has been opened at South Georgia, and 1000 letters and 389 postcards were despatched to various countries by the mail which left on the 23rd December 1909". Mr J. I. Wilson, who had been appointed Stipendiary Magistrate at South Georgia from 20 November 1909, was the postmaster.

JAMES ANDREWS

23 KINCATH AVENUE,
BURNSIDE,
RUTHERGLEN
17 July 1956

ANTARCTIC ICE TERMINOLOGY: "ICEBERG TONGUES"

A "glacier tongue" is defined in the recent illustrated ice glossary (*Polar Record*, Vol. 8, No. 52, 1956, p. 6) as "an extension of a glacier projecting seaward and usually afloat". In general, such glacier tongues break up, a short distance out from the coast, into an accumulation of discrete icebergs which are usually aground and may or may not be connected by bay ice or fast ice.

In the *Polar Record*, Vol. 8, No. 52, 1956, p. 65, there is a discussion concerning the term "ice stream" first proposed in the *Polar Record*, Vol. 7, No. 48, 1954, p. 185 and p. 231. A term of this sort is much needed, and I am in favour of the term "Ice stream" which has been proposed.

When such an "ice stream" meets the coast it frequently produces a "glacier tongue". There are, however, many examples along the coast of Antarctica of tongues which occur with no glacier or ice stream behind them. The inland ice sheet sweeps down uniformly to the coast. At some places it breaks off at the coast to form icebergs which presumably are swept away if the water is deep, and the coast remains as an untramelled one of sheer, vertical ice cliffs. However, for no reason as yet advanced, the ice sheet in other places cracks up upon reaching the coast to form a number of discrete mounds of ice heavily crevassed, whose separations increase with their distances from the coast. For some distance out the spaces between these "icebergs" may be choked with fast ice and drift snow, but as the bergs become more dispersed further from the coast they are generally joined by thin fast ice.

I wish to propose the term "iceberg tongue" for such a feature which is not backed by a glacier or an ice stream.

One possible reason for an "iceberg tongue" is a series of low rocky hills at the coast (similar to the Vestfold Hills or Hordern Hills in the Australian sector) over which the ice sheet rides and cracks asunder. A shallow bank at sea beyond the coast is then needed to ground the icebergs produced and prevent them from drifting away.

I should perhaps mention that there is a distinction between an "iceberg tongue" and an "iceberg bank". The latter term has been used in Greenland for an accumulation of icebergs grounded on a shallow bank at sea. The term has not found use in Antarctica for it is generally assumed that around the antarctic coast any "bank" will be studded with grounded bergs. Thus, in our present region of activity, the Fram Bank and the Four Ladies Bank are regions of iceberg accumulation. Such iceberg banks need not, however, be connected to the coast and in general are not.

An iceberg tongue on the other hand is (like a glacier tongue) an extension of the continental ice sheet out into the sea.

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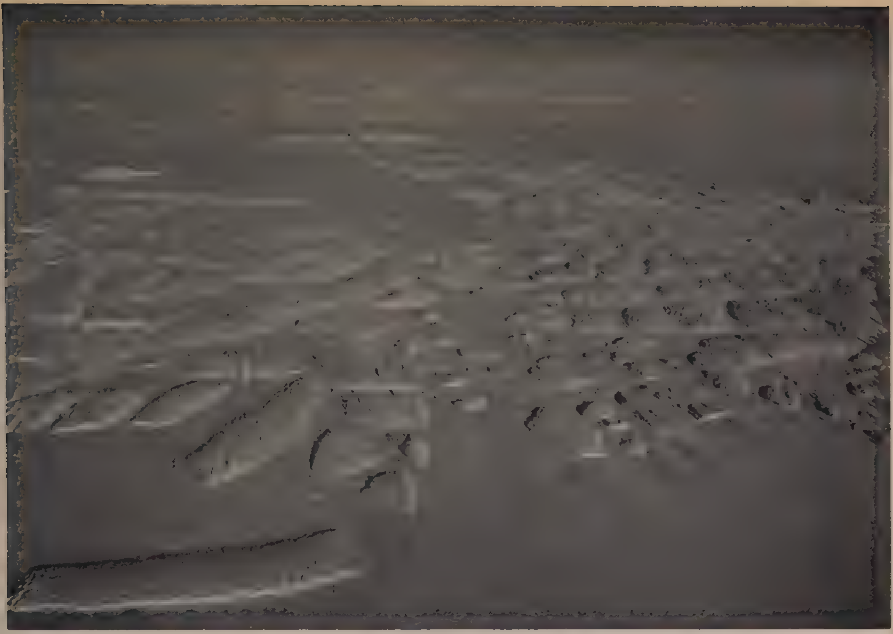
31 July 1956



Iceberg tongue at eastern limit of Davis Bay. The icebergs extend into open water to the left of the photograph

Beginning of iceberg tongue. Note that there is no defined glacier or ice stream

Photographs A.N.A.R.E.

(*Facing p.* 376)

OBITUARY

Helmer Julius Hanssen, the Norwegian sailor and polar explorer, was born at Andøya in north Norway and died in Tromsø on 2 August 1956 at the age of 86. He worked as a fisherman, sealer and whaler from the time he was 12. In 1897 he was mate on the *Laura* which took J. H. Pearson's ornithological expedition to Novaya Zemlya. In 1898 he was master of the sealer *Ellida*. Hanssen then became Amundsen's second mate on the *Gjøa* during her voyage through the Northwest Passage in 1903–06. He joined Amundsen again on the latter's antarctic expedition of 1910–12 and was one of the party who reached the South Pole, on 15 December 1911. Hanssen served Amundsen yet again as master of the *Maud* during her voyage through the Northeast Passage in 1918–20. When the vessel was frozen in at Ostrov Ayon, Hanssen and the mate, O. Wisting, travelled by sledge round the coast to Anadyr in order to telegraph to Norway; the journey took from December 1919 to June 1920. In 1924 Hanssen took part in Binney's Oxford University Arctic Expedition as dog expert, and in 1928 accompanied Villinger, who was making a film in the Arctic for "Ufa", to Spitsbergen and Anmagssalik in east Greenland.

Amundsen considered him the finest dog driver he knew, and also remarked on his wonderful eyesight. In 1936 Hanssen published his autobiographical *Voyages of a modern Viking* (London, Routledge).

Hugo Holten Møller was born on 19 April 1900 and died on 21 March 1956. In 1925 he was a member of the first group of wireless operators to be stationed in Greenland. During the war Møller served in the organization established in New York to maintain supplies to Greenland. In 1946, at Grønlands Styrelse in Copenhagen, he became responsible for the Greenland radio organization and later took over the direction of the entire electrification programme in Greenland.

Vladimir Afanas'yevich Obruchev died in the U.S.S.R. on 19 June 1956, aged 92. He was the doyen of Russian geologists. Among his published works, numbering over a thousand, are found many on the geology of Siberia. From the point of view of Arctic studies, his monumental annotated bibliography *Istoriya geologicheskogo issledovaniya Sibiri* [*History of the geological exploration of Siberia*] which came out in 13 parts between 1931 and 1946, is an essential aid. His own field work was largely in southern Siberia and central Asia.

Obruchev was also a pioneer in the study of permafrost. Elected Academician in 1929, he was the Director of the Academy's Institute of Permafrost Studies [*Institut Merzlotovedeniya*] from its establishment (under another name) in 1930 until a few days before his death. In 1939 the Institute was named after him.

Morten Pedersen Porsild, the Danish scientist, was born at Glibstrup in Denmark in 1872 and died on 30 April 1956. In 1898 he accompanied K. J. V. Steenstrup's expedition to Disko in west Greenland. In 1900 he took his degree in botany, and in 1902 led his own botanical expedition to Disko. He saw the difficulties of research in Greenland by means of summer expeditions only, and planned a permanent station which would do work all the year round. While supporting himself as an assistant in botanical gardens or as a teacher he agitated vigorously for this idea, and in 1906, with the financial support of A. Holch and the State, Den danske arktiske Station was established near Godhavn on Disko (*Polar Record*, Vol. 7, No. 50, 1955, p. 422–23). It is the oldest scientific station in the Arctic, and was for many years the only one. Porsild himself was director of the station for forty years, from its foundation until 1946. Porsild did not confine himself to botany but also studied Eskimo archaeology and ethnology. Many of the works in the large number of issues of *Meddelelser om Grønland* which are grouped under the subtitle of *Arbejder fra den danske arktiske Station paa Disko* ("Works from the Danish arctic station on Disko") are his. Porsild spoke Greenlandic and was elected to Godhavn's kommunestâd (Commune Council). From 1927 to 1938, as Godhavn's representative, he was the only Dane in Nordgrønland's landsråd (Provincial Council).

OTTO YUL'YEVICH SHMIDT died in the U.S.S.R. on 7 September 1956. He was born in 1891, and was a university teacher of mathematics before the Revolution. After it, he held a number of senior civil service posts in various commissariats, and was then in turn Head of the State Publishing House [Gosizdat], Deputy Head of the Central Statistical Administration [Tsentral'noye Statisticheskoye Upravleniye], and a member of the State Planning Commission [Gosplan]. During this period he continued to be a professor of mathematics and published a number of important mathematical works. He was also a keen climber with an interest in glaciology. In 1929 he made his first arctic expedition, to Zemlya Frantsa-Iosifa. In 1930 he became Director of the Arctic Institute, and in 1932 was elected an Academician. In the same year he became the Head of the newly formed government department created to develop the Arctic, the Chief Administration of the Northern Sea Route [Glavsevmorput']. He occupied this position for over six years, a period of rapid expansion and great activity in the Soviet Arctic. Shmidt himself led many expeditions, notably those in the *Sibiryakov* in 1932, the ill-fated *Chelyuskin* in 1933–34, and the establishment of Papanin's drifting station (later called SP-1) at the North Pole in 1937. In 1935 he visited Cambridge and established the first personal contact between Soviet explorers and the Scott Polar Research Institute. After his dismissal from the Northern Sea Route Administration in 1939—at this time of the great purges he was lucky only to be dismissed—he continued his scientific work, which included editorship of scientific journals and of the *Bol'shaya Sovetskaya Entsiklopediya* [*Great Soviet Encyclopedia*], and turned his attention to problems of geophysics and astronomy. He was highly versatile, and a man of conspicuous ability. The strong position which the U.S.S.R. now holds in all fields of polar research and exploitation is in no small measure due to his work and influence.

Engineer Vice-Admiral Sir REGINALD SKELTON, R.N. (retired), was born in Lincolnshire in 1872, and died at Adlingbourne on 5 September 1956. Captain Michael Barne, R.N. (retired), who is the only surviving commissioned officer of the British National (*Discovery*) Expedition, 1901–04, writes of him as follows:

> "I first made his acquaintance in 1900 in H.M.S. *Majestic*, flagship of the Channel Fleet, in which vessel he was serving in the rank of senior engineer, Captain Scott being first lieutenant and myself a sublieutenant. Captain Scott's hopes of commanding an Antarctic expedition were at that time in little more than an embryonic state, but he confided them to Skelton and myself, with an offer of our accompanying him should it ever come to pass. I am sure that Skelton jumped at the offer as eagerly as I did.
>
> "Skelton, as chief engineer of the *Discovery*, attended her almost from the laying of her keel. The ship was equipped with an auxiliary engine, steam capstan, winches and many other mechanical appurtenances as her frame grew, and it was due to his skill and foresight that Captain Scott was able to write in

> his book *The voyage of the Discovery* 'from first to last of our voyage we never had serious difficulty with our machinery or with anything concerning it'.
>
> "As our voyage, following the usual sailing ship route, carried us into the higher southern latitudes we fell in with many seabirds not all of which were well known except to expert ornithologists, and there was considerable competition amongst us in catching the rarer specimens following the ship. The means of catching them varied, and one of the most successful of us was our chief engineer, who to his messmates was known as 'Skelly'. After our arrival in winter quarters, near the south-west corner of Ross Island, our first sledge journey was despatched on 4 March 1902 to place a conspicuous mark in the neighbourhood of Cape Crozier, which would guide any relief ship to the position of the *Discovery* during the next southern summer. Among this party were Skelton and myself, the leader being our first lieutenant, Charles Royds.
>
> "Among Skelton's many accomplishments was photography and he was recognized as photographer-in-chief to the expedition. He was indeed a man of many parts as witness the almost constant work of repairs, large and small, in progress in his chilly place of work down in the engine room during our two successive winters in the ice. His domain lacked the warm amenities of ward-room or mess deck. Not only could he contrive the forging of heavy tools, but repairs to scientific instruments requiring skilled precision of work came equally easily to him. Skelton took an important part in several sledge journeys. He it was who discovered a breeding place of Emperor Penguins near Cape Crozier. Most of his sledge journeys were exploratory, across McMurdo Sound, and up the Ferrar Glacier, which, in a letter to me dated 23 March 1956, he describes as the most suitable route through the coastal mountains. I would I had space to remark further on this officer, describing further his vivid personality, his humorous disposition and exceptional reasoning power, lasting up till his end. A few years after our return in 1904 I enjoyed his company once more, when experimenting with motor sledges in Norway and the Alps. Captain Scott had asked both of us to come on his second expedition, but neither of us was able to accept his invitation."

During part of the 1914–18 war he was in charge of the dockyard and installations at Archangel. He retired from the Navy in 1932 and was for some years a director of John I. Thornycroft and Co., the shipbuilders and engineers.

Commander W. F. Skelton, R.N., has presented a valuable collection of his father's antarctic papers and photographs to the Scott Polar Research Institute.

RECENT POLAR LITERATURE

This selected bibliography has been prepared by R. J. Adie, Terence Armstrong, T. H. Ellison, Amorey Gethin, J. W. Glen, W. B. Harland, H. G. R. King, Brian Roberts and Ann Savours. Its main field is the polar regions, but it also includes other related subjects such as "applied" glaciology (e.g. snow ploughs and ice engineering). For the literature on the scientific study of snow and ice and of their effects on the earth, readers should consult the bibliographies in each issue of the *Journal of Glaciology*. For Russian material, the system of transliteration used is that agreed by the U.S. Board on Geographic Names and the Permanent Committee on Geographical Names for British Official Use in 1947 (see *Polar Record*, Vol. 6, No. 44, 1952, p. 546).

Reprints of "Recent Polar Literature", from Nos. 37/38 onwards, can be obtained separately (to allow references to be cut out for pasting on index cards) from the Institute, price 2*s*. 6*d*. for two reprints. Copies will be sent without charge to organizations with which the Institute maintains exchange arrangements and which notify their wish to receive them. Readers can greatly assist by sending copies of their publications to the library of the Institute.

To increase the usefulness of the bibliography entries have been arranged provisionally under subject headings in classified order according to the Universal Decimal Classification. When circumstances permit the decimal notation will be included, together with a key.

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ERRATA

The *Polar Record*, No. 53, May 1956

Page 167, line 150. *For* Alvaposse *read* Alba-Posse
Page 167, line 53. *For* Robiolo *read* Robiola
Page 183, line 7. *For* 8 *read* 16
Page 183, line 8. *Omit* leader of the summer party. [B. Imbert led this party.]
Page 183, line 10. *For* 2 *read* 1
Page 183, line 26. *For* François Tabuteau *read* G. Rouillon

The *Polar Record*, No. 54, September 1956

Page 220, line 1. *For* Shottan *read* Shotton
Page 262, line 11. *For* large-scale survey *read* triangulation for the large-scale survey
Page 262, line 12. *For* Kenny *read* Kenney; *for* 1955. *read* 1955; the remainder of the year being spent on plane-table work. The survey was completed in February 1956.
Page 262, line 13. *After* 14 July *add* 1955
Page 262, line 34. *For* 300 *read* 3000
Page 273, line 38. *For* Skrifter *read* *Skrifter*
Page 276, line 13. *For* 35 *read* 3.35
Page 299, line 53. *For* Nowell *read* Nöel

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PRINTED IN GREAT BRITAIN AT THE UNIVERSITY PRESS, CAMBRIDGE
(BROOKE CRUTCHLEY, UNIVERSITY PRINTER)